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ABSTRACT

This volume is the third in a series of self-portraits of projects that receive funding from the Fund for the Improvement of Postsecondary Education (FIPSE). The 31 essays in this volume are grouped around seven main themes: (1) school-to-college transition and retention; (2) rewarding effective teaching; (3) improving teaching and learning; (4) improving the undergraduate curriculum; (5) assessment: (6) teacher education, and (7) postgraduate curriculum and instruction. Institutions and organizations represented by these projects include: University of Michigan; Rollins College (Florida); Eastern Washington University; Anne Arundel Community College (Maryland); City University of New York-The City College; City University of New York-College of Staten Island; University of Nebraska at Lincoln; Rhode Island College; Mount Holyoke College (Massachusetts); Saint Anselm College (New Hampshire); University of Delaware; Washington State University; California State University at Northridge; Texas College of Osteopathic Medicine; The Community College of Aurora (Colorado); University of Minnesota; Kennesaw State College (Georgia); University of Oregon; University of Connecticut; Miami University (Ohio); University of Wisconsin at Madison; Mathematical Association of America; Baylor College of Medicine (Texas); University of California at Berkeley; The Center for Applied Linguistics (Virginia); New York Hall of Science; Pace University (New York); California School of Professional Psychology at Alameda; Georgetown University Law Center (District of Columbia). (CH)

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LESSONS LEARNED FROM FIPSE PROJECTS III

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Lessons Learned FROM FIPSE Projects III

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PREFACE

As most readers of this volume know, the Fund for the Improvement of Postsecondary Education is a federal program housed within the U.S. Department of Education, designed to promote innovation in teaching and learning at the postsecondary level with modest amounts of venture capital.

This is the third volume of *Lessons Learned from FIPSE Projects*. Like its predecessors, it is essentially an exhibition of self-portraits of projects that received funding from FIPSE. In the case of each portrait, the grant has ended, at least some of the results are in, and the campus people who worked on the project are summing up. Did the innovation work? What went well, and what didn't? Has the innovation survived at the original site? What do the innovators have to share with those who want to consider adapting the innovation on their own campus?

As with all self-portraits, here too the biases of the sitter cannot be discounted, but there are grounds for confidence. Above all, these reports have been scrutinized, probed, drafted and edited by FIPSE's evaluation specialist, Dr. Dora Marcus, in collaboration with program officer Dr. Eulalia Cobb and consultant Dr. Robert Shoenberg, and with the able technical assistance of Susan McGraw. To them we owe thanks for the most useful of these volumes yet.

Part of what makes this volume so useful is that FIPSE's approach to project evaluation has matured over the past decade. But part of its usefulness is context. American higher education is in the middle of a revolution, or more exactly, two. On the one hand, large social and economic forces are pressing new austerities on higher education. Particularly in state legislatures, there is great resistance to the historical pattern of budget increases for colleges and universities. These austerities make "change by addition, rather than substitution" less feasible than in richer times, and even a phase of local experimentation is often unaffordable.

But at the same time, complacency about the status quo has suddenly become difficult to sustain. There are major new demands that colleges and universities document performance for the public. More than half the states have decreed that public institutions report on performance annually, often in dozens of categories, ranging from faculty contact hours to alumni satisfaction to graduation rates. (Interestingly, the idea of assessing student learning outcomes, which was the parent of this multi-factor performance reporting movement, has not grown along with its offspring; indeed in many states student learning outcomes are a quite minor part of the performance reports required from the institutions.)

It is the very coincidence of these two revolutions that makes this third volume of *Lessons Learned* so timely: the fact that higher educators can no longer afford to reinvent the wheel, combined with the new premium being put on demonstrable success. It is time, then, that public and private foundations, public funders, and others concerned about postsecondary education began to focus on helping higher educators everywhere learn from each other's successes. By spreading the word about an interesting set of attempted reforms in several key categories, this volume makes a worthwhile contribution.

However the challenge should not be underestimated. Previous *Lessons Learned* volumes have been in high demand by institutions of higher education, and many thousands have been sent out. But the step from knowledge to action is another story. Research by Vanderbilt University economists has recently shown that innovations spread much more slowly in higher education than in business or agriculture, without resolving the reason why. FIPSE's own experience confirms and expands on this result: colleges and universities often ask FIPSE to support innovations, but they much less often ask FIPSE to support adaptations of innovations already established elsewhere, even when special solicitations are issued.

A natural conclusion is that the series of *Lessons Learned* volumes ought to continue, and that they should be part of a broad strategy aimed at lowering non-informational obstacles to the dissemination of education reform.

Charles H. Karelis, Director
Fund for the Improvement of Postsecondary Education

OVERVIEW

The FIPSE-funded projects featured in this volume represent college and university educators at their most creative and most effective. FIPSE's focus on educational innovation and the intense competition for Comprehensive Program grants mean that the approximately seven percent of proposals that receive funding in a typical year will include a lot of very good ideas.

The projects described here not only began with promising ideas, but also carried them out well and achieved meaningful results and useful, hard-won lessons. They convince through force of logic, through the enthusiasm of both those who made them work and those who benefitted from them, and through the objective assessment of their outcomes.

Some of these projects received their original funding in 1989, and none later than 1992. Most were completed in 1992 and 1993, although a few are more recent. Accordingly, they reflect the prominent student-focused concerns of higher education in the early part of this decade.

Simply comparing the table of contents for this third volume of Lessons Learned with that of the second volume reveals some informative continuities and contrasts. For example, Volume II included a large number of projects focused on teaching innovations in specific disciplines. Volume III contains very few such projects but instead reveals an emphasis on innovations that enhance general skills development, particularly those which address the difficulties experienced by underprepared students. If this selection of projects is in any way representative, it would appear that colleges and universities continue to revisit, with new intensity and fresh ideas, a persistent set of problems.

While original efforts in post-baccalaureate education have always been included among FIPSE projects, the most successful of these efforts are sufficiently numerous to merit special attention in this volume. This development reflects growing interest in changing curriculum and instruction for postgraduate professional programs. The trend is worth watching. So is the trend for non-collegiate institutions to involve themselves extensively in teacher training, as demonstrated in the last section of this volume.

What is missing, however, is as important as what has been added. Most notable is the infrequency of projects focused on general education. A first wave of general education reform, directed at correcting the movement away from requirements in the 1960's and 1970's, was very visible among FIPSE-funded projects in the 1980's. This first wave of general education reforms seems to have receded at the end of the decade. Needless to say, however, all is not changed. Assessment and the use of computer technology to enhance instruction continue to be significant interests.

The brief introductions to each group of similarly-focused projects attempt to tease out more of these trends. We thus invite the readers of these volumes to consider the FIPSE projects they describe not only as a source of good ideas to enhance their own institutions' work but as mirrors, however imperfect, of the concerns of postsecondary education as a whole.

SCHOOL-TO-COLLEGE TRANSITION AND RETENTION

At the interface of school and college, these projects work to increase the rate of college success of such students as non-native speakers of English, single parents or the disadvantaged. Aside from their commonality of purpose, the projects generally exhibit features that are suggestive of trends in this field:

—They have adapted or applied strategies developed in other contexts to the special populations they serve, e.g., a "whole language" approach applied to the teaching of English composition (CUNY City College, "Fluency First" program); undergraduate research models to help disadvantaged students identify with the mission of the university (University of Michigan); community development and collaborative learning strategies to support the college success of single parents on public assistance (Eastern Washington University); the "learning community" model to retain beginning students in science majors (Rollins College).

—They use personal support strategies to foster the acquisition of academic skills, e.g., mentoring (Anne Arundel Community College); instruction in study skills (CUNY City College PASS Program); discovery-oriented laboratories (CUNY College of Staten Island); and public agency support (Eastern Washington).

—They establish creative and rigorous assessment strategies to demonstrate their superiority over standard treatments, a characteristic that often contributes to institutionalization of the program. The two City College programs and the University of Michigan project include particularly strong assessment models.

These projects on transition and retention reflect the most effective innovations of two decades of efforts to enhance the success of non-traditional students.

UNIVERSITY OF MICHIGAN
Evaluation and Dissemination of an Undergraduate Program to Improve Retention

Purpose

To increase the retention and improve the academic performance of underrepresented students, the university developed the Undergraduate Research Opportunity Program (UROP) in 1989. UROP is based on the theory that one of the causes for the high attrition of minority students (six out of ten for African Americans, versus three out of ten for whites, nationwide) is lack of intellectual identification with the institution, and that personal contact with faculty—a comparative rarity for undergraduates at large research institutions—can help to achieve this identification.

UROP pairs first-year and second-year students with faculty to collaborate on original research projects. Students also participate in an intensive peer advising program and a series of workshops focusing on specific skills such as time management. In its first four years, UROP grew from fourteen students to 143. In 1994-95, about 600 students participated. Although in the beginning UROP involved only minority students, the program was eventually extended to include students from all ethnic and racial backgrounds.

In 1992 the university obtained FIPSE funds to conduct an evaluation of UROP which sought to determine its effect on student academic performance and retention to graduation, as well as on students' attitudes towards their intellectual development. It also intended to measure UROP's effect on faculty perceptions of students, and to review the general mechanics of the program.

Innovative Features

Although many universities have recognized the value of involving undergraduates in collaborative research with faculty, this is the first project grounded on the theory that this collaboration is most beneficial in the first two years of college, the time when the heaviest attrition occurs.

Students may earn academic credit by participating in UROP. The number of credits is determined by the number of hours students agree to devote to collaborative research. Students on financial aid who nevertheless find it necessary to work receive special grants financed by the university.

Peer advisers, specially-trained UROP "alumni," meet regularly with their assigned students to discuss all aspects of life at the university, and make referrals as needed. In addition, peer advisers coordinate groups of students working on related projects for informal presentations and discussions. Throughout the year, UROP staff arrange workshops and other activities for participants.

UROP is also the first undergraduate research program to undergo an evaluation of the scope of that funded by FIPSE. To date, project staff have gathered retention and academic performance data on 859 students who participated in UROP, and on 837 control students who did not.

All students in a cohort who apply to UROP each year are sorted into sub-groups based on ethnicity, SAT/ACT scores, and high school grades. Students within each of the sub-groups are then matched and randomly assigned to UROP or the control group for that year.

The retention and academic performance data for students in UROP and the control group include individual registration status, enrollment information, cumulative GPA, demographic information and entrance test scores. Retention is defined as persistence through graduation. The only academic criterion for participation in UROP is a 2.0 GPA from high school or from the first year in college.

To gauge the social and psychological changes effected by UROP, participating students and controls are administered surveys at the beginning and end of each academic year. The surveys include, among others, self-reports of self-esteem, attitudes toward the multicultural environment on campus, and sense of identification with the university. UROP faculty are evaluated for attitude changes through a questionnaire designed to measure attitudes about race, opinions about race relations on campus, causes of student attrition, and their expectations and beliefs about UROP students.

Project Impact

By all indications to date, UROP has been a success, especially for students from underrepresented minorities. UROP students from these groups have an attrition rate about 56 percent lower than that of underrepresented students in general (10.3 percent versus 23.3 percent). When minority UROP participants are compared to matched minority controls, UROP participants have an attrition rate 35 percent lower than the controls (10.3 percent versus 15.9 percent).

There are insufficient numbers of Hispanic and Native American students in the database to measure UROP's effects on these groups specifically. However, there are sufficient numbers of African American students in the sample, and for them the effects are clear: African American UROP participants have a 45 percent lower attrition than the matched controls (10.1 percent versus 18.4 percent).

UROP also has an effect on the retention of majority students: the attrition for white UROP students is 3.2 percent, while that for the matched controls is 6.1 percent—a 48 percent difference. However, given the small numbers of students who drop out in both groups, the difference is not statistically significant. The same applies to Asian students.

In summary, the data suggest a definite positive effect on retention rates. The effect varies according to the racial or ethnic group, but is most pronounced for African-American students.

UROP appears to be most beneficial for students who exhibit the lowest academic performance, as indicated by below median scores in high school GPA for freshmen or the first-year GPA for sophomores. Among students with relatively high GPAs, the effects on attrition are small: for minority students, 4.8 percent for UROP versus 7.0 percent for controls; for majority students, 3.7 percent for UROP versus 3.3 percent for controls. For students whose GPAs fall below the median, however, the effects are considerable. For minority students, the difference in attrition between UROP participants and controls is 16.9 percent versus 23.7 percent. For white participants the figure is 4.0 percent, versus 8.5 percent for controls.

The data also reveal that UROP's effects on attrition are stronger for second year students than for freshmen. The effects on freshmen are: for minority students, 11.9 percent for UROP versus 14.4 percent for controls; for whites, 5.3 percent for UROP versus 6.4 percent for controls. For second year students, however, the effects are: for minorities, 7.5 percent for UROP versus 17.9 percent for controls; for majority students, 1.6 percent for UROP versus 5.7 percent for controls.

Participation in UROP also seems to affect GPA. For minority students, UROP results in a 5 percent gain, and a 2 percent gain for majority students. As with retention, the effect on GPA is greatest for the least prepared students. Among UROP minority students, those with low GPAs improved by 6 percent, while those with relatively high GPAs improved only by 2 percent. White students with low GPAs improved by 3 percent, while those with high GPAs did not improve at all.

Results of the survey of social and psychological variables so far show that UROP students feel increased self-confidence in their skills.

Nevertheless, none of the positive attitudinal changes reported by students predict the retention and academic performance effects outlined above.

Analysis of the results of the faculty survey confirms that faculty who participate in UROP gain a stronger appreciation of the value of diversity in the university and an understanding of the barriers that minority students encounter than non-participating faculty.

Lessons Learned

Since research to date has not shown why UROP causes the dramatic changes in performance and retention, project staff are now attempting to find this out by asking students to recall specific behaviors in which they engaged, such as number of conversations with faculty, and number of hours spent studying, working with other students, consulting advisers, and so on. In addition, UROP students and controls who have now graduated will be interviewed to determine the program's long-term effects.

Project Continuation and Recognition

UROP has been formally institutionalized—in the 94-95 academic year, it enrolled approximately 600 students, a number that grew to 800 in 1995-96. Considered one of the principal innovations in the university's revitalization of its undergraduate curriculum, UROP is a major focus of the university's current capital campaign, which is expected to raise a 3 million dollar endowment for the project.

UROP personnel have answered numerous inquiries about the program, and have made presentations at conferences in the U.S. and Canada. Manuscripts are in preparation for submission to various journals. In 1995 the project received another Comprehensive Program award from FIPSE to complete the evaluation of UROP. In 1996, UROP was one of five recipients of the TIAA/CREF sponsored Theodore M. Hesburgh Award. The award criteria included: significance of program to higher education; appropriate program rationale; and successful results and impact on undergraduate teaching and student learning.

Available Information

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ROLLINS COLLEGE
The Science Community Year—Addressing Attrition in Science

Purpose

The Science Community Year (SCY) was designed to help retain students in science and mathematics courses and majors. It is a learning community model in which a group of students enrolled in a common set of courses meets in seminar to integrate the learning from those courses. The seminar is led by a "master learner," a faculty member who is himself or herself a novice in math or one of the sciences and who takes the courses along with the students.

Open to any freshman student taking more than one mathematics or science course, the SCY seminar met once a week for 75 minutes, and gave students an opportunity to talk about their experiences in science, to work on problem-solving skills, to learn about the history and philosophy of mathematics and science, and to take field trips demonstrating the applicability of their learning to possible careers. The master learners were non-science faculty, in one case the president emeritus. In addition to struggling through the courses with the students, the master learners helped to convey to course instructors a sense of students' problems and frustrations, thus contributing to considerable pedagogical and curricular change.

Innovative Features

Using the learning community model to serve the purpose of retention was a variation on an approach which, since its inception at SUNY/Stony Brook in the mid-1970s, has been adapted to a wide variety of circumstances. At Rollins, the seminar served primarily to build community and help students to cope with a particularly demanding curriculum, rather than integrate learning. Although students were enrolled in two or more mathematics or science courses concurrently, the courses were not the same ones in all instances. Instead, students shared the experience of being freshmen and trying to get established as science students.

Evaluation

The informal discussion in the SCY seminar of the freshmen's and the master learner's experiences and problems in their math/science courses provided a continuing formative evaluation of the SCY. The project director also arranged for two qualitative evaluations, after the first and fourth years of the project, by faculty from other institutions who were known for their expertise in science pedagogy.

The most direct evidence of the SCY's efficacy came from comparing the course enrollment patterns of SCY and non-SCY students following the first semester. Of the non-SCY students, 56 percent enrolled in the second part of two-semester course sequences begun during their first semester at Rollins; 53 percent completed this second course. Students in the SCY seminar had a course re-enrollment rate of 71 percent and a completion rate of 68 percent.

Of those who enrolled in the first semester of the introductory science sequence, 17 percent of non-SCY students went on to declare majors in science, as opposed to 35 percent of SCY students. Of those who completed the second semester of the sequence, 31 percent of non-SCY students declared a science major, while 51 percent of SCY students did so.

Since high school grade point averages and SAT scores of SCY and non-SCY students were virtually identical, these large differences in outcome cannot be attributed to differences in basic ability. Initial interest in science, however, was not controlled.

No significant difference was observed in the persistence in science courses of male and female SCY students as compared to their non-SCY counterparts. SCY men and women went on in science in approximately equal proportions, and exceeded the rates for non-SCY men and women to roughly the same degree. However, in a puzzling result, approximately equal percentages of SCY and non-SCY minority students continued in science; the SCY did not have the effect on minority students that it did on the group as a whole.

Project Impact

The informal feedback that departments obtained through the master learners contributed to a revision of biology laboratories to make them more investigative, a reconsideration by the chemistry department of the pace of its beginning course, and the introduction of student journal writing in freshman mathematics courses as a way of providing feedback for the instructor.

As a result of the SCY experience, Rollins introduced courses into its January term that support skill development in chemistry, calculus, and pre-calculus. The science and social science divisions organized a Quantitative Teaching and Learning Center to parallel the English Department's Writing Center.

Lessons Learned

Feedback from students indicates the clear value of the support and encouragement provided by the SCY community. According to students, knowing that they and their master learners were in the same situation and had to face the same problems was the most important aspect of the seminars. They also found the field trips, and the link they established between theory and practice, of significant value.

The problem-solving exercises elicited mixed reviews, and the readings in history and philosophy distinctly negative ones. These have been replaced with readings on current science topics of general interest.

Students' realization of their deficiencies in science study skills resulted in some additional emphasis on these matters.

Project Continuation

The SCY program was absorbed into the "College Conference Courses," a first-year requirement for all students. Students are assigned to the Conference Course taught by their freshman year adviser. Two sections of SCY, now a one-semester, three-credit course, are normally offered. However, the SCY seminar was not taught in 1996.

The SCY program did significantly affect the organization of the Conference Courses by matching, for the first time, students' academic interests with advisers in those disciplines.

Available Information

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EASTERN WASHINGTON UNIVERSITY
The Single Parent Project

Purpose

In the past, the practical barriers that single parents face in attending and staying in school have not received appropriate attention from higher education institutions and governmental agencies. The Single Parent Project (SPP) at Eastern Washington University (EWU), in collaboration with several state agencies, was designed to lower those barriers so that single parents may not only attend college but graduate, and by finding reasonable employment, leave public assistance.

Innovative Features

Participation in the Single Parent Project was open to 275 Eastern Washington University students on public assistance. Staff used outings into the community to convey to students a "sense of shared situation" in their daily encounters with staff and the demands of college. Students were grouped in dorms and an hospitable Drop-In Center encouraged social networking. Staff made available counseling in crisis intervention and advocacy, as well as financial aid, internships, child care, food and clothing.

The academic program consisted of an adaptation of the Treisman model of collaborative learning using student work groups in specially designed mathematics, biology and English courses. Since retention was the project's primary focus, staff contacted students whose grades dropped to offer special services and assistance.

A diversity of programs during the summer taught the essential elements of leadership, communication, and conflict management to single parents and their children. On-campus and community resources combined to respond flexibly to the special circumstances of low-income single parents.

Evaluation

Participation and retention rates, grades, employment, and enrollment in graduate school were documented over the life of SPP. Staff collected information on referrals, counseling case loads, and the use of Drop-In Center, and interviewed student participants, graduates, EWU staff and faculty.

Project Impact

Use of the Treisman model in an introductory biology course serves as an example of SPP's impact on learning upon a small sample of non-traditional students. Participants scored one final grade higher than non-participants, several changed their majors to biology due to this experience and fewer dropped the course.

Survey responses from various university administrators and faculty who had worked closely with SPP, but not as part of its staff, judged its activities positively, but expressed regret that it only included students on public assistance. Every respondent felt that SPP effectively served single parents attending the University, and that it was important to continue to provide these specialized services. SPP participants felt that the program helped them with aspects of both their school and family life and was vital to their remaining in school and getting out of poverty.

The evaluator, who had formerly directed a similar program at the University of Utah, reported that SPP "confirmed widespread national opinion that it is among the best in the country...because of its unusually effective coordination of the services low income single parents need to enroll in and graduate from college."

Of the 275 students who went through the intake process, only six dropped out of the SPP events and services during the grant period. The majority of the program's participants (55 percent) were seniors as of

April 1992, and 64 percent of them maintained a 3.0 or greater GPA compared to other seniors.

Project Continuation

SPP was housed administratively within the Office of Student Life, with its own coordinator of non-traditional students programs. The University's top administrators and Board of Trustees approved a family complex of residential units that was constructed in 1993, giving priority to students who are single parents.

A former practicum student embarked on an adaptation of SPP at Kodiak Community College in Alaska with funds from the Carl D. Perkins Vocational Education Award.

Recognition

In 1990, the Washington State Legislature authorized the creation of a resource manual, On Your Way: A Guide for Single Parent Students, jointly prepared and distributed by the Higher Education Coordinating Board in Washington and SPP.

The Governor of the State attended the University graduation ceremony and acknowledged in the media the importance of programs like SPP in higher education. SPP's project director received the local YWCA Leadership Award for Outstanding Achievement in Education.

Available Information

In the last few years, two videos on SPP were produced, giving a face to the variety of project activities and student participants. A resource manual offering service referrals and advice to single parents was distributed across the state. The final report and appendices to FIPSE fully describe the project's development and characteristics.

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ANNE ARUNDEL COMMUNITY COLLEGE
Supplemental Instruction With Mentoring Support

Purpose

All across the nation, community colleges are striving to reconcile their open admissions policy with the obligation to give students a reasonable chance of fulfilling their academic goals. The project at Anne Arundel Community College—an adaptation of a University of Kansas model for four-year institutions—explored some non-traditional ways to provide students in required science, mathematics, business and social sciences courses the support they needed for academic survival and success.

Innovative Features

The project consists of regularly-scheduled study sessions for courses in the areas mentioned above. The sessions are conducted by student leaders who themselves have completed the course in the past. These students undergo a three-credit practicum at the beginning of the semester, and then reenroll in the course alongside the participants in their study sessions. In the sessions, the student leaders demonstrate study strategies such as collaborative problem-solving, graphic representation of abstract concepts, practice tests, memorization techniques, and learning games.

Each student leader is paired with a faculty mentor who has participated in a three-day training seminar on pedagogical issues. For the first four weeks of the semester, faculty mentors participate as learners in the courses and study sessions whose student leaders they supervise. Mentors are placed in courses outside their disciplines in order to allow students to observe and emulate their learning behaviors, and they keep a journal in which they record their observations about teaching and learning.

Study sessions are visited by a community mentor, who speaks about the particular discipline from the point of view of a practicing professional. At the end of the semester, community mentors and students are given information on pursuing further contacts, such as student visits to the mentor's workplace.

Evaluation

All students enrolled in the 42 classes which offered Supplemental Instruction during the three years of the original project served as evaluation subjects. 765 students in these classes participated in Supplemental Instruction: 1,188 did not.

At the end of the project, profiles were drawn up for all students. These included age, gender, ethnicity, grade point averages, test scores, admissions status, credits attempted, retention rates, family income, parental education level, source of education funds, and marital, parenting, and disability status.

Analysis of these profiles showed that Supplemental Instruction participants and non-participants did not differ significantly in their demographic profiles. The two groups did differ significantly, however, in their fall-to-spring retention rates, their average grades and their course success rates. (Course success was defined as earning a grade of C or better, including Pass. Unsuccessful grades were D, F, Withdrawal, Withdrawal with Pass, and Withdrawal with F.)

Project Impact

Students who attended Supplemental Instruction sessions earned higher grades in the course—an overall mean grade of 2.7—than those who did not (1.8 grade average). The course success rate for project participants was 78 percent, versus 44 percent for non-participants. Participants had higher fall-to-spring retention rates than non-participants (86 percent versus 72 percent). The mean grade-point average for participants was 2.68, versus 2.24 for non-participants.

Students attended an average of eight Supplemental Instruction sessions per semester. There was no correlation between the number of sessions attended and the course grade. Students who attended the sessions rated them as being very helpful—4.6 on a Likert scale—and reported that they had received help in all the study and intellectual skills that the sessions had been designed to address. Students found contact with community mentors an effective way of connecting their academic work to their career aspirations.

Faculty mentors believed that the program allowed them to broaden their pedagogical expertise and their perspectives on student learning. They valued the opportunity to become learners again, gaining empathy for students and becoming familiar with a colleague's discipline and teaching. As supervisors of student leaders they planned lessons, developed teaching materials, and came into close contact with outstanding students. And the overall process encouraged faculty to reflect on and discuss many different aspects of teaching.

Lessons Learned

Faculty interest in the mentor component of the project increased considerably when the College added faculty development to the institution's strategic plan. For faculty evaluation purposes, the College agreed to regard service as mentor as equivalent to earning one graduate credit. As a result, the project now has a core of fifteen faculty members who function as mentors.

Project Continuation and Recognition

The project has been fully institutionalized, and continues to thrive despite budget cuts. Data on student success and average grades are systematically collected and continue to confirm the success of the project's approach, even after grant funding ended several years ago. The project has very recently received a second FIPSE grant to adapt this supplemental instruction program on four additional community college campuses.

The project has been presented at several national conferences, including the Annual Association of Community Colleges and Leadership 2000. The project director has assisted a number of community colleges in adapting the program, and has worked with the Johns Hopkins University School of Continuing Studies to implement the faculty development component.

Available Information

Project materials (a manual, a videotape, and a collection of articles) may be obtained from:

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CUNY - THE CITY COLLEGE
Fluency First in English as a Second Language

Purpose

To reduce the high failure rate of non-native English speakers in writing courses, this project tested the viability of a "whole language" approach to teaching English as a second language. Rather than emphasizing grammatical correctness in the first English as a Second Language (ESL) courses, instructors concentrate on developing fluency in English usage. "Fluency First" is based on the work of Mayher, Lester and Pradl as presented in Learning to Write/Writing to Learn.

Innovative Features

The well-explored "whole language" approach to second language learning stresses a more natural use of oral and written language, rather than narrowly confining discourse to a particular aspect of grammar that is the focus of a given lesson. The Fluency First project adapted these techniques to a college-age population. Twenty-seven adjunct faculty received extensive training before the courses began.

Fluency First comprises a three-course ESL sequence in which students proceed from fluency to clarity to correctness. Students are first taught to write intelligibly and with relative ease, and to comprehend popular fiction. In the second phase, students pursue clarity—writing lexically accurate, well-organized and developed prose. The third phase focuses on grammatical and mechanical correctness. In all three courses, students read about 1,000 pages of unabridged text, and write upwards of 10,000 words. This heavy exposure is innovative in the ESL field and intends to augment and accelerate language acquisition.

Evaluation

Project directors were able to collect data regarding the success of ESL students in later work in English composition for two years (1983 and 1986) preceding the introduction of Fluency First, and for the three years of the project (1989-1991). With the exception of one year, the data cover more than 800 students per year.

An evaluator external to the program visited classes and training sessions, and elicited opinions and comments from ESL students and teachers who participated in Fluency First.

Project Impact

Between 1983 and 1991 the percentage of students satisfactorily completing the last of the three ESL courses on the first try increased from 38 percent to 77 percent, with the most dramatic increase coming in the last year. Those students who began their ESL program with the second course passed the third course on their first attempt at an even higher rate, more than 85 percent—up from about 51 percent in 1983.

Fluency First students found it easier to pass the College-required English composition course. Whereas in 1983 students had tried this course an average 1.47 times before passing it, by 1991 the average was down to 1.07 attempts. In other words, the vast majority passed it on the first try.

Lessons Learned

The data accumulated on student success were highly influential in persuading other instructors to try Fluency First. Their efforts in turn helped the project directors to refine their approach and define more carefully their criteria for measuring success.

The data collected measure students' performance in writing English. Fluency First puts equal emphasis on reading, but efforts to arrive at a reliable assessment of reading ability improvement for these students have been unsatisfactory. Similarly, the value of this approach for improving speaking and listening skills has not been determined, since the focus of the ESL courses is on reading and writing. There appear to be some collateral gains in oral skills, but they have not been measured.

While the majority of ESL instructors were enthusiastic about Fluency First, some full-time faculty resisted it and did not wish to participate in the process of developing and implementing the strategies. This reaction reinforces the importance of involving as many faculty as possible in pedagogical innovation.

Project Continuation

Fluency First continues to thrive in CCNY's English as a Second Language Department. The program's leadership is training new teachers on campus and at other CUNY colleges that have adopted the approach. The database on student performance continues to grow. Information on over 8000 students demonstrates that success rates in passing basic college writing courses are over twice as high as before the introduction of Fluency First.

Dissemination

Workshops on Fluency First attracted 250 faculty from CUNY campuses and the New York City public schools, and more than 90 percent of the participants in these workshops have since used at least some part of the Fluency First approach in their teaching. It is now the official approach at three other CUNY colleges—Kingsborough and Bronx Community College and Baruch College—as well as Monroe Community College in Rochester and Union County College in New Jersey. The project directors made presentations at international, national and state meetings of ESL teachers, and published four textbooks and monographs.

Recently, Fluency First has been awarded a two-year FIPSE dissemination grant to adapt the "whole language" model to six additional college and university sites.

Available Information

Program director Adele MacGowan-Gilhooly has made a teleconference videotape which, with accompanying written materials, provides a good introduction to the use of whole language methods in the college setting. It is available from TESOL International, Alexandria, VA (703-836-0774). The Fluency First project is described in the first issue, March, 1991, of College ESL and in the Journal of Basic Writing, Spring 1991 issue.

Those interested may read about the Fluency First Approach in Achieving Fluency in English and Achieving Clarity in English, both by Adele MacGowan-Gilhooly and published by Kendall-Hunt, and in Fluency First: A Whole-Language Guidebook for ESL and BW Teachers, by Betsy Rohrschach, to be published by Heinemann-Boynton/Cook. To receive the Fluency First training via e-mail, teachers may subscribe to TESL-L@CUNYVM.CUNY.EDU, and join the TESLFF-L list.

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CUNY - THE CITY COLLEGE
Access to Science Study (PASS)

Purpose

The Program for Access to Science Study (PASS) is designed for students unprepared for science and math courses at the college level. PASS consists of a preparatory science course taught in tandem with a special counseling seminar. The course introduces the students to chemistry and physics topics by means of problem sets, related experiments, and a quiz. The counseling seminar is designed to promote students' ability to monitor, evaluate and adjust their behavior in order to achieve their academic and personal goals. The focus of the course and seminar is on developing the problem solving skills, academic habits, discipline and attitudes that will allow students to succeed in science-based fields.

Innovative Features

PASS focuses not only on the development of problem-solving skills in a scientific context but also on giving students an understanding of the kind of learning that is expected in college, and help in gaining control over their personal lives as it impacts on their studies. PASS recognizes that many students, used to succeeding through rote memorization, have not learned more complex reasoning skills. It addresses the problems of those who have never had to study outside of class and thus do not know how to manage time, create adequate study space, manage work and family demands, or exercise the self-discipline necessary to succeed in college.

The instructional component of each section is taught by a science graduate student, while qualified counselors teach the seminars. Undergraduate students lead the group problem solving tutorials. All receive careful training and meet weekly with the project coordinators to discuss the progress of individual students as well as that of the program as a whole.

Evaluation

Groups of students requiring a preparatory science course had a choice between the PASS program and the long established parallel course, Chemistry 5. Students chose between the two on the basis of scheduling preference, word of mouth, or advisement. The progress of students in both groups was followed and the two groups were compared over the following two semesters in terms of the correlation of their PASS/Chemistry 5 grades with GPA's and performance in subsequent science and math courses.

Project staff tracked PASS students on a variety of other measures, such as retention rates and success rates in science and math courses compared with the overall college success rates in the same courses. Staff evaluated the application of problem solving strategies emphasized in PASS and obtained correlations between student and instructor evaluations of the attainment of skills and attitudes that were the focus of PASS, as well as correlations between performance in PASS and measures of changes in behaviors.

Project Impact

The substantial data collected and analyzed demonstrated that PASS students had a significantly higher retention rate than the general college population (Table 1). The level of performance in PASS was a strong predictor of future academic performance, both in general and in math and science courses in particular, which was not true of the comparison group (Tables 2, 3). The instructor evaluations and student self-evaluations indicated that students who were successful in PASS had developed positive attitudes and behaviors that lead to academic success, particularly as regards their problem solving abilities and their ability to manage their personal lives.

Table 1

Retention Rates

Cohort	PASS Students	General College Population
Fall 1989	85% entering freshmen retained after 5 semesters	59% entering freshmen retained after 4 semesters
Fall 1990	83% entering freshmen retained after 3 semesters	75% entering freshmen retained after 2 semesters
Spring 1991	95% retained after 2 semesters	
Fall 1991	95% retained after 1 semester	

Table 2

Grade Point Averages (End of Spring 1992 semester)
Correlated with Grades in Pass and Chemistry 5 Grades

Cohort	PASS Correlation	Chem 5 Correlation
Fall 1991	.62 ($P < .01$)	.35 ($P < .05$)
Spring 1991	.62 ($P < .01$)	No significant results
Fall 1990	.47 ($P < .01$)	NA
Fall 1989	.62 ($P < .01$)	NA

Table 3

Course Grades Correlated with PASS Grades

Cohort	Course	Correlation
Fall 1991	Intermed. Algebra.	.67 (N=15)
	Pre-Calculus	.70 (N=12)
	Trigonometry	.55 (N=10)
Spring 1991	Intermed. Algebra	.81 (N=10)
	Pre-Calculus	.94 (N= 8)
Fall 1990	Pre-Calculus	.61 (N=23)
	Trigonometry	.59 (N=24)
Fall 1989	Intermed. Algebra	.62 (N=27)
	Pre-Calculus	.62 (N=29)
	General Chem I	.51 (N=28)
	General Chem 2	.61 (N=11)
	General Chem Lab	.53 (N=10)

All values significant at the .01 level

Lessons Learned

The PASS project demonstrates the advantage of giving underprepared students a full semester of specific training in problem solving and self-management skills before involving them in math and science courses that require learning behaviors with which they are unfamiliar. The directors have also learned that the seminar's focus on behaviors and attitudes can best be handled as part of the course itself, rather than as a separate activity.

Although the PASS and comparable groups entered the introductory courses with the same background, only the PASS group acquired skills that can be transferred to other courses. PASS encourages students to assess themselves and their progress realistically, and, most importantly, to accept the challenge of future academic work instead of shrinking from it. It emphasizes an interactive atmosphere which produces active learners. It encourages students to take control of their academic lives and trains them to be effective students. Ordinary introductory courses may be effective in teaching science material, but they do not teach the transferable skills which lead to success in future courses.

Project Continuation and Recognition

Two sections of PASS are offered each semester. The counseling portion requires external funding, but the College covers all other costs. The strength of the program's effects on students and of the documentation of their growth has been validated by the Performance Effectiveness Panel of the National Diffusion Network.

Dissemination

Recently, the project was awarded a second FIPSE grant to disseminate PASS to a diverse group of New York institutions, public and private, two- and four-year, liberal arts and research.

Available Information

More extensive data about course outcomes, staff training and program management, curriculum and adaptation of the course are available from:

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CUNY - COLLEGE OF STATEN ISLAND
Project Discovery

Purpose

Only 22 percent of students in New York City high schools complete the academic program and earn the so-called Regents Diploma, which is necessary for admission to college without remediation. Most of the students who earn a Regents Diploma are honors students. The average students who begin high school in the academic track, on the other hand, tend to drift off into non-Regents courses, and do not receive the advice or support that would help them to persist in a program more useful to their futures.

In this project, College of Staten Island faculty worked with two high schools, one in Staten Island and one in Brooklyn, both with even smaller percentages of students earning the Regents Diploma than is average for the City. They helped high school teachers to design and implement a program that would better hold the interest of average students and reduce the rate of attrition, absenteeism, and uncompleted assignments in high school, and the need for remediation should they get to college.

Innovative Features

Project Discovery used two strategies to overcome the alienation and boredom characteristic of the target population of students. First, teachers attempted to get students actively involved in their own learning, designing discovery-oriented laboratories and exercises in which students learn for themselves rather than simply listening to lectures and memorizing. Second, they created an integrated curriculum in which a team of English, social studies, science and mathematics teachers, working with a common group of students, coordinated the work being done in their separate classes. Students were purposely recruited from the average (neither honors nor remedial) group and randomly assigned to the classes. While these strategies have been successfully implemented elsewhere, their use with this population is unusual.

Prior to FIPSE funding, a pilot of the program had been run with a group of freshmen in the Staten Island high school. The grant allowed a second group to have this experience as freshmen and to continue it into the sophomore and junior years. The Brooklyn school began the program under the grant.

Evaluation

An independent evaluator interviewed teachers and administrators, systematically explored student gains in writing and critical thinking skills, and compared Discovery participants and non-participants on course registration, passing rates, scores on Regents Examinations, and attendance rates.

Project Impact

At the Staten Island high school, Discovery students performed significantly better than the non-participating controls on almost all counts. Attendance rates during the three years of the project were around 95 percent, from five to fifteen percent higher than the control group.

The critical thinking skills of ninth grade Discovery students improved by about one standard deviation, but these same students showed less gain after the tenth grade. In the ninth grade, participants performed better on the Regents biology exam and had a higher passing rate than a comparable group. They also scored better on the Sequential Mathematics test.

Tenth graders who had participated for two years were significantly more likely to pass Regents exams in chemistry, math and global studies than their non-participating peers. In the eleventh grade they passed physics, math and U.S. history and government tests at higher rates. In math and physics, they were far more often enrolled in the Discovery courses than non-participants. Participants' grade point averages were significantly higher than non-participants' in both ninth and tenth grades. The program did not, however, have any significant effect on the writing performance of students, nor did their test scores and passing rates equal those of honors students.

Students were not the only ones to feel the impact of the project. Discovery teachers developed a greater sense of intellectual collegiality, experienced more control over the curriculum, improved their skills in helping students to discover ideas, and learned to teach without trying to control the outcome. Enthusiasm for the program in the Staten Island high school is such that the entire school is adopting the Discovery program.

At the Brooklyn school, on the other hand, almost no differences in attendance or performance were observed in Discovery students. In the first year, this was probably because remedial students were assigned to the Discovery program. Even with a fresh start in the second year, however, Discovery Program students performed no better than the control group.

The project directors and the evaluator attributed this difference in results between the two schools to a much greater sense of program ownership by teachers in the Staten Island school, despite equal enthusiasm on the part of both groups of instructors. Administrative interest and cooperation seem to have been greater in the Staten Island program, which also had a longer duration than the one at the Brooklyn school.

Lessons Learned

The project directors and the evaluator emphasize the need for teacher ownership of the program. At the beginning of their work together, the Staten Island teachers relied heavily on the college faculty for ideas.

When the teachers began to take charge intellectually, the energy of the program increased markedly. This transformation never occurred at the Brooklyn school.

The project clearly demonstrates the possibility of improving student performance using discovery strategies and relating academic topics to each other and to problems that are tangible to students. Field trips, such as one to Ellis Island that began a unit on immigration, illustrate this principle.

College and school faculty learned that there is no ideal theme or structure for curriculum integration. The important aspect of integration for teachers is the exciting intellectual process of working out themes and patterns. This process, however, can only take place in a school whose administrators support it.

Project Continuation

The Discovery program design has been adopted for the entire Staten Island high school, with support from the Board of Education. The project directors and participating teachers have had numerous opportunities to present their work to teachers and administrators in the New York City school system and have aroused interest in many quarters.

In addition, a second FIPSE grant now in its final year (Project Discovery II) has allowed for the further testing of this project in the Staten Island school, this time not with average students but with those entering high school below grade level. Although the final evaluation has not been completed, to date the same procedures applied with these students have not produced similarly successful results, and the project has met with a series of obstacles. These include such practices as assigning the least able teachers to underachieving students; scheduling these students for their most important classes in the worst times of the day and shifting them from one class to another as need arises, destroying the block programming which is essential to the Project Discovery approach.

Lastly, school troublemakers inevitably filter downward into these classes, from which they cannot be expelled because there is nowhere else to put them. Despite these obstacles, however, some success in raising achievement levels has resulted.

Because of their experience in the FIPSE projects, the College has awarded the co-project directors additional released time and has contributed to further development of a Discovery Center to initiate and disseminate similar projects. The College has also hired four of the Project Discovery high school teachers as adjuncts to disseminate the Discovery idea.

Available Information

A publication describing the project and the process for implementing it is in preparation. Information is available from:

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REWARDING EFFECTIVE TEACHING

The two projects included in this group presaged the increase in attention now being given to questions of faculty roles and rewards. The University of Nebraska project was conducted simultaneously with the discussions preceding the publication of Ernest Boyer's influential Scholarship Reconsidered and can be seen as a laboratory for exploring at a research university the issues that the Boyer work made a part of the national dialogue. The Rhode Island College project tests empirically the question of whether there is or can be a connection between student learning and faculty rewards for teaching.

UNIVERSITY OF NEBRASKA AT LINCOLN
Improving Teaching at a Research-Oriented University

Purpose

This project aimed at improving the climate for undergraduate teaching at a large, research-oriented state university flagship campus. Project staff worked systematically with a total of 28 departments in the College of Agricultural Sciences and Natural Resources, and the College of Arts and Sciences to strengthen the climate for teaching and learning, enhance recognition of teaching excellence, and assist each department in developing plans for achieving these two goals. The largest amount of activity went on within individual departments: four joined the project in the first year, eight more in the second, and an additional 16 in the third. The project directors provided information, directed faculty to useful written materials on the topic of faculty rewards, and helped to frame issues. In turn, each department directed its efforts to developing written plans for documenting, evaluating and rewarding teaching excellence.

In a parallel effort at the institutional level, administrators developed a series of specific strategies to support and encourage increased attention to teaching achievements in promotion and tenure decisions.

Innovative Features

"From Regard to Reward" has been the largest and most systematic effort to date to influence the status of undergraduate teaching at a research university. It is also unusual in the coordinated involvement of both faculty and administrators, and in the ability of the project staff to document the results of their efforts.

Evaluation

A planning grant from FIPSE prior to the beginning of the project had allowed the university to gather baseline information concerning faculty opinions about the campus climate for teaching and perceptions about the relative weights of teaching and research in faculty tenure and promotion decisions. This data not only helped to define the problem that the university wished to address but provided a basis for measuring the effects of the project in changing attitudes and perceptions.

Pre/post-project data were gathered on faculty estimates of such matters as:

—the status of teaching versus research in hiring and tenure decisions;
—general perceptions about the importance of teaching well;
—the quality of efforts to improve teaching;
—the climate for teaching and teaching improvement in the department and college;
—the intensity of department and college leadership commitment to support efforts of recognition of good teaching and encourage improvement;
—the quality of teaching evaluation.

These quantitative data, gathered through questionnaires, were supplemented by an external evaluator's structured interviews with participating faculty and administrators, using the twelve participating departments in years one and two as the treatment group, and the sixteen Year 3 departments, who were only beginning their work at the time of evaluation, as the control group. The new departmental policy and procedure documents and an account of observable actions and changes provide additional evidence of the project's success.

Project Impact

The data support claims of statistically significant (in the case of quantitative measures) and important improvements in the climate for teaching, the concern for teaching ability in personnel decisions, the documentation of teaching performance, and rewards for good teaching. As would be expected, not all units made equal progress nor does every measure show positive change. But most measures reveal quite positive results, and many interesting and apparently successful models have emerged from this work.

Some of the more striking results include:

1. In 25 of 28 participating departments faculty generated and adopted written plans for documenting, evaluating, and rewarding teaching.

2. Statistically significant positive changes occurred in faculty perceptions that:

—the need to teach well is more balanced with the need to publish;
—the climate in their college is favorable for teaching improvement;
—teaching is emphasized in hiring decisions;
—chairs give consideration to teaching in annual reviews;
—multiple sources of data are used in evaluating teaching;
—teaching is appropriately weighted in tenure, promotion, and merit decisions at both departmental and college levels;
—specific goals are being set for teaching improvement; and
—support for teaching improvement is available.

3. Individual department plans include such strategies as:

- —regularly scheduled small group faculty discussions about teaching;
- —teaching portfolios;
- —five-year peer review of the way courses are taught;
- —lists of criteria for excellence in teaching; and
- —credit for teaching improvement activities.

4. The project generated such widely useful materials as a resource manual, a process manual, a list of "pressure points" for effecting change, and workshop materials.

5. Administrators developed 25 action strategies to exploit the pressure points, including:

- —revised position descriptions linking rewards to expectations;
- —modified evaluation procedures for tenure, promotion, and merit pay awards;
- —teaching demonstrations by candidates for faculty appointment;
- —awards for instructional improvement; and
- —a capital campaign to create "distinguished teaching" chairs.

Lessons Learned

Wide involvement of faculty in the participating departments resulted not only in specific teaching evaluation and recognition plans but in a sense of community within and among the units. The involvement of administrators along with faculty and coordinated efforts among the administrators produced a pervasive and consistent message to the faculty, assuring them that their efforts would be recognized and accepted. In other words, this project demonstrated again the value of communication and grassroots ownership.

Continuation

Ten additional departments, supported by university funds, joined the teaching reward and recognition effort after the FIPSE-funded work ended, for a total of 36 units now actively pursuing change. The work has been strongly supported by the Vice Chancellor for Academic Affairs through funding of a Project on Rewarding Teaching. By institutional policy, excellence in teaching and research are now being rewarded equally.

Dissemination

A dissemination grant from FIPSE has permitted UN-L to train faculty and administrators from 18 research institutions to undertake similar efforts on their own campuses, assisted by visits from UN-L faculty who counsel and lead workshops. Three national conferences that included workshops and a teleconference have further spread results of the project.

Available Information

Individual department plans, a resource manual, a process manual and a list of pressure points for effecting change, along with a summary report on the project and its evaluation are available from:

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RHODE ISLAND COLLEGE

Investigating a Linkage Between Reward for Good Teaching and Improved Student Performance

Purpose

To investigate the relationship between faculty incentives and student learning, seven departments (sociology, chemistry, social work, nursing, management, modern languages, and special education) elaborated plans to establish learning goals, assist students in reaching them, and assess the result of their efforts.

Departments used FIPSE funds in two ways: to compensate faculty through release time or monetary stipends for their participation in the project (these funds were made available throughout the course of the activities), and to reward those whose students made significant learning gains by granting support for professional development activities such as travel or equipment purchases.

Innovative Features

The project was departmentally based and, although strongly supported by the administration, developed from the bottom up. Faculty from the seven participating departments planned independent projects that differed significantly in their methodologies, proposed outcomes, and rewards.

Nevertheless, the seven departmental projects shared three features. Each established an intervention strategy aimed at enhancing student learning; each provided one or more assessment methods to document learning; and each specified faculty incentives for participation.

An Advisory Committee composed of at least one member of each participating department and various administrators, including the Vice

President for Academic Affairs, monitored the departmental projects and voted on fund expenditures. Despite the variations in goals and assessment programs, departmental representatives used the Committee's regular meetings to learn techniques to stimulate learning that might be useful in their own departments, and to obtain assistance with problems of measurement or morale.

The departments of special education and modern languages did not complete the project. The five remaining departments succeeded in documenting greater learning gains by students participating in the project than by their non-participating peers or predecessors and received the reward funds.

The following department-by-department summary of the projects should give an idea of the range of goals and strategies:

Sociology—The principal strategies for improving learning consisted of measuring student achievement and improving advising. The project achieved this by closely monitoring the aggregate and individual progress of its majors through a variety of instruments and by establishing a system of intensive student advising whereby faculty fed information about progress back to the student.

Chemistry—Department faculty met regularly to discuss ways of bringing students to a higher level of performance in such areas as recording laboratory data and in curricular matters such as better integration of courses.

Management—In the experimental sections of 19 courses, instructors adopted a Teaching and Learning by Objectives approach adapted from the Management by Objectives philosophy. In each course, a control section was conducted according to traditional pedagogies. With the help of their advisers, students in the experimental sections each prepared an Individual Learning Plan, which was then modified through discussion with their course instructor. In addition, faculty met with each student approximately three times per semester to review progress and satisfaction.

Social Work—The faculty's goal was to improve the direct practice skills of students. To achieve this, faculty provided a special laboratory in which students did exercises involving such techniques as role playing, case presentations with small-group brainstorming, and problem-solving.

Nursing—The Department developed a non-graded seminar to foster the socialization and professional development of baccalaureate nursing students and to help them to create a healing relationship and environment for their patients. Students were encouraged to develop and enhance their skills of reflection, to identify their feelings about interactions with patients, and to explore the relationship between accountability and responsibility.

Evaluation and Project Impact

Departments developed several means of documenting student learning improvements. Many were multidimensional, and all sought to reflect the different goals of each department.

Sociology—Student progress was measured through a departmental examination developed during the project and the ETS major field examination, both of which were administered at the entrance, midpoint, and end of the major. In addition, students completed a research project at the beginning and the end of the major and videotaped presentations at the beginning and the end of the core courses in the major.

Seniors' scores on the ETS major field examination were significantly higher for the classes involved in the grant than for previous groups, and scores on the departmentally developed inventory improved during the course of the project. Compared to the performance of classes before the project, student papers evidenced more complex research designs and better writing. Oral presentation skills also improved.

Chemistry—Faculty administered standardized examinations, a self-assessment survey, and a questionnaire. They reviewed student laboratory work and papers in courses taken early and late in the major. They probed students' knowledge of the principles and facts of chemistry; their writing skills; their ability to solve problems, apply mathematics and interpret scientific data; their experience with computers, instrumentation and chemical literature; and their career goals.

Over the course of the project, faculty observed the following changes compared to prior generations of students: students dramatically increased their computer skills; they showed greater independence in laboratory work; more majors engaged in research under the direction of faculty members; more students made presentations at annual research conferences and submitted papers that won recognition in national competitions; student scores on standardized exams rose; and oral presentations showed improved organization, clarity, research, and use of visual aids.

Management—Participating students were evaluated on whether they met the objectives they had determined jointly with faculty. Pre- and post-tests were administered to the experimental and control sections of each course. Faculty developed comprehensive examinations to assess aggregate student learning levels, and to compare the performance of students who were involved in the project with those who were not.

Overall, the different measures demonstrated that the project made a significant difference in student learning of course contents and the development of managerial skills. An attitude survey revealed that students felt the project had been helpful to them.

Social Work—The practice instructor and the field instructor conducted pre- and post-assessments of five practice skill areas among experimental and control students. Self-assessments by students in both groups were also compared. The practice skills of students who had completed the experimental laboratory showed significantly greater improvement in three of five areas than those of the control group. As a result, skill building content for several social work courses within the practice sequence was enhanced. During the school's last accreditation review, the site visit team of the Council on Social Work Education praised the strength of the practice sequence. In addition, the Masters of Social Work Program was revised two years ago to institutionalize the skills laboratory created as an experimental part of the FIPSE project. Because of the laboratory's success, two required social work practice courses have been increased from three credit to four credit courses, each requiring a skills laboratory component.

Nursing—Clinical faculty and the leader of the experimental seminar evaluated the extent to which experimental and control students had progressed toward desired professional goals. The results demonstrated that the clinical performance of the students in the seminar—as opposed to course grades or performance on other measures—was significantly higher than that of the control group. In clinical settings, seminar students exhibited greater self-awareness, responsibility and accountability than the controls.

In addition to the above assessments of student performance, a cross-departmental survey analysis of the entire project was conducted by members of the sociology faculty and is discussed below.

Lessons Learned

Departments made various uses of FIPSE funds. Some used funds at the end of the project to reward faculty for improved student learning with travel monies or equipment purchases. On the other hand, some used funds to compensate faculty for participation in the project (i.e., release time to teach an experimental laboratory section). Still others used part of their funds to finance student travel to conferences.

Given this range of uses of incentive funds, and given that there was no attempt to compare the performance of students of faculty who had been promised incentives with that of students whose instructors did not participate in the project, it is not possible to determine precisely the impact of faculty rewards on student learning.

The faculty themselves seemed to think that the effect of the rewards was minor. The survey of participating faculty conducted by the cross-departmental analysis team revealed that only one respondent felt that the prospect of rewards had constituted the entire motivation for participation in the project. A slightly larger number indicated that they were not at all influenced by incentive funds. Seventy-seven per cent of the respondents stated that the prospect of rewards had played some role in motivating their work.

In responses to the survey and to informal polling, many faculty reported that their participation in the project derived principally from a sense of professional obligation; others stated that they had been motivated less by the monetary incentives than by the formal commitment implied by the grant; and still others mentioned that the funds were too insignificant and too far removed in time from the work they were intended to reward to serve as major motivators. On the whole, the prospect of rewards seems to have provided some but by no means the entire motivation for faculty efforts to improve student learning.

In addition, the cross-departmental analysis yielded the following insights into the process of improving teaching and learning on a departmental basis:

1. Although all attempts to improve learning should identify goals, it is desirable for such goals to retain a certain flexibility, since the ability to continue to discuss and refine goals in the course of the project may contribute to faculty ownership of a program. If the program wishes to elicit broad faculty participation, a democratic, decentralized organization seems to foster satisfaction and retention.

2. A multidimensional approach to assessment is valuable not only because it ensures reliability and validity but also because a battery of measures can be scaled back, revised or augmented if practical problems or ideological shifts warrant. Home grown measures of learning created collaboratively by the faculty produce the sense of involvement that is crucial to faculty satisfaction with and participation in a project. Progress toward discipline-based cognitive learning goals may be easier to document than improvements in generic skills such as writing and speaking.

3. Student attrition in experimental groups may constitute a significant problem. Planners should allow for student incentives to ensure retention. Feedback to students is important for assessment projects to yield full fruit.

4. Large-scale changes in pedagogy may be less effective in improving learning than joint faculty reconsideration of general goals and increased opportunities for faculty/student contact.

5. If the program involves faculty in performing clearly delimited additional tasks (such as developing or teaching an extra course) it is more beneficial to remunerate faculty for their efforts by giving them release time or extra compensation than to promise end-of-program incentives.

Project Continuation

Even though participating departments did not continue all aspects of their individual projects, various strategies and activities originating from FIPSE funding continue. For example, the vice president for academic affairs has continued support of the sociology department's assessment efforts by paying for use of ETS examinations administered to graduating seniors. Part of at least one department meeting every year is devoted to a review of the ETS exams.

The "Teaching/Learning By Objectives" project implemented in the department of economics and management seems to be having some long-lasting effects. Some faculty members, particularly those who originally participated in the project, have embraced the Management By Objectives (MBO) philosophy as a methodology and as an instrument in their teachings. The attempts on the part of the project director and the department chair to disseminate the basic ideas of "Teaching/Learning by Objectives" (TLBOs) through briefings, individualized discussions, committees and departmental retreats have enticed some faculty members to internalize the basic TLBOs philosophy and integrate its ideas into their course syllabi, their teaching styles, and their relations with students.

Moreover, the departmental student advising system is now almost fully institutionalized. Advisers spend a great deal of time with their advisees, try to help them in developing both learning and career objectives, and guide them toward achieving their objectives.

Other continuing activities introduced during the FIPSE project include:

Faculty still meet once a semester to discuss the progress of each of the majors and have expanded this practice to include physics and science education majors.

One general advising meeting with the students is held each semester. Most of the faculty are present during these sessions, and the students are made aware of the requirements of the major, the educational goals and when various courses are offered.

The college continues to emphasize computer skills, especially spreadsheet skills, which are now being utilized in the analytical chemistry and physics courses in addition to the physical chemistry course. Computer interfacing is slowly becoming more significant in laboratory courses, and heavy emphasis is placed on training students in the skills of data recording in the sciences.

Microscale methods continue to be used in the organic chemistry course.

Available Information

Further information may be obtained from:

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IMPROVING TEACHING AND LEARNING

This group of projects provides a fine sample of the wide-ranging and creative uses of computer technology to enhance student performance. Applications that demonstrate the value of technology range from teaching composition (St. Anselm College) and advanced mathematics (Mount Holyoke College) to teaching medical diagnosis (Texas College of Osteopathic Medicine), enabling speech pathology students to both "see" and hear the problems they are studying (Washington State University), and helping learning disabled students with writing tasks (California State University at Northridge). But lest we become uncritical enthusiasts, another project (University of Delaware) raises questions about the value of one hopeful form of computer use for less able students.

Two innovative efforts explore further the growing trend to using student group work as a teaching strategy. St. Anselm College and Mount Holyoke College have combined collaborative learning with computer support in their projects.

MOUNT HOLYOKE COLLEGE

Increasing Access to Advanced Mathematics

Purpose

Mathematics faculty at Mount Holyoke College believed that students not majoring in mathematics would find interesting and applicable to their majors certain topics ordinarily taught in advanced mathematics courses. However, because these courses usually had four prerequisites, they were not accessible to non-math majors. This project aimed to add courses to the mathematics curriculum that would allow students majoring in other disciplines to study these advanced mathematical concepts.

Innovative Features

Seven courses containing topics of potential interest to non-mathematics majors were revised so that they required, with one exception, only one or two semesters of prior mathematics courses at the Calculus I level or higher. Courses thus revised included: Analytic Number Theory: Lie Groups; Mathematical Statistics; Differential Equations with modelling; Polyhedral Differential Geometry; Symmetry, Groups and Geometry; and Theory of Equations.

A prerequisite for several of theses courses is a Laboratory in Mathematical Experimentation ("the Lab") where students work in small groups, with the aid of a computer, on six or seven research topics ranging widely across mathematics. They construct examples, look for patterns, formulate conjectures, and try to support them with proof. The faculty's experience in the Lab with the power of collaborative learning and the exploration of rich examples shaped the seven revised courses, to the benefit of math majors and non-majors alike.

Evaluation

To be sure that the revised courses did not damage the quality of the mathematics major by changing its sequencing or making undue concessions to non-majors, the department invited mathematics faculty from other institutions to sit in on the courses. Though they were originally intended to provide quality control, they also helped in resolving pedagogical and mathematical difficulties. Their reports were taken into account in revising the courses for future offerings.

In addition, students were surveyed by an outside evaluator in each of the three years of the project to determine their attitudes toward mathematics both before and after the courses, their impressions with regard to the adequacy of computer training, the usefulness of the small groups, and the value of other instructional components.

Project Impact

Faculty quickly discovered that given limited resources, if they wanted to institutionalize the new courses, they would have to substitute them for courses already being taught. Thus the department ended up reducing the number of prerequisites that mathematics majors would need for these advanced courses, in the process making many more courses available to students earlier in the major. This redesign of the major became the major impact of the project, since non-mathematics majors who were supposed to be the principal beneficiaries of this work constituted only five percent of the actual enrollments.

On the other hand, mathematics majors who took these courses discovered that they could, with comparatively little mathematical experience, use computers to take on big, messy problems. This discovery led some to participate in summer research or internships, which further built their confidence. The fact that the number of mathematics majors has increased substantially over the time of this project suggests that the new instructional strategies intended for non majors may be of substantial benefit in gaining and retaining majors.

Survey results showed no overall effect on the anxiety level of students, which is not surprising given that the courses were taken primarily by students already committed to a mathematics major. However, half of the students reported a more positive attitude toward mathematics, another outcome that correlates with the increase in the number of majors.

Two other surveys, one by a researcher at the University of Connecticut, and the other by the Mathematical Association of America, specifically identified the laboratory course as a primary factor in encouraging women to major in math and the early access to a wide variety of courses as a secondary one.

Lessons Learned

With judicious use of computers, relatively inexperienced students can grapple with complicated and advanced topics in a way that builds their understanding of important mathematical concepts. Early in the major, students appreciate the breadth and diversity of the discipline and the fundamental and complementary roles of investigation and proof.

The experience of this project led the Mathematics Department at Mount Holyoke to question the highly sequential structure of the mathematics major as it exists at most institutions. They find that students who take courses similar to the ones resulting from the project before the standard junior-level theoretical courses in algebra and analysis get much more out of these courses and are better able to see connections among them.

The project directors are now convinced that it is possible to build a mathematics major around junior-senior level courses that are accessible to students in other disciplines. They have successfully put into place an array of attractive courses that reduce prerequisites but do not undermine the intellectual rigor of the major. They suspect that the situation in most science majors is similar and that the highly hierarchical nature of traditional curricular models is due more to historical convention than to necessity.

Project Continuation

All but one of the courses, in their revised forms, continue to be offered on a regular basis and are accessible to all students at some time after the freshman year. The syllabi, assignments, teaching notes, etc. have been fully documented, so that all instructors can teach the courses.

Project Recognition

The Mathematics Department at Mount Holyoke was cited as one of the ten exemplary mathematics departments in the country by the Mathematics Association of America. The visiting committee especially noted as unusual and admirable the very flexible prerequisite structure, which enables non-majors to penetrate deeply into the discipline.

Available Information

Copies of an article about the thinking that underlies the project and the ideas about reducing prerequisites, along with information about the specific courses, are available from:

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SAINT ANSELM COLLEGE
Using Computers for Collaborative Writing

Purpose

As Saint Anselm faculty learned more about the difficulties that students have with their writing, it became increasingly clear that the inability to think critically while composing essays, regardless of discipline, is as problematic as the lack of mastery of writing mechanics. Faculty noted that, on exams, students could produce short answers which repeated information given to them by their instructors or found in their texts, but when they were required to relate one idea to another, generate their own questions or synthesize information, they floundered.

The problem, as diagnosed by the project director, was that "students are rarely given the opportunity to use group writing as a process of discovery, to clarify their initial questions and ideas; to discuss ideas from the readings with each other and their teachers; to relate one paper or idea to earlier ones; or to revise an essay after submitting it for a first reading." There was very little collaboration or interaction between students and their teachers and peers during the writing process.

As a result, the college embarked on an interdisciplinary experiment that assumed that collaborative writing can be used as a way of learning. To counter the tradition of students writing alone, instructors formed co-authoring groups of three students to write common essays at the computer. Faculty then critiqued these essays "on line" as drafts evolved in a continuing student-teacher dialogue. This provided the opportunity for faculty to see students' minds at work and for the students to watch each other write.

Intensive summer workshops were held to train faculty in the mechanics of co-authoring, to revise syllabi and curricula and to learn to use computer networks. Five hundred students and fourteen faculty from a variety of disciplines in the sciences and humanities participated in this experiment to change the teaching and learning of writing.

Innovative Features

In this design, not only did students co-author on-line essays in small groups, but each essay contained a negotiated co-authored text and a hidden text of individually authored comments. The latter could include student questions, complaints, discussions or reflections on writing the essays. Faculty used the hidden text to make suggestions about reworking weak sections, or to question the logic of the arguments.

Evaluation

Evaluation included comparison groups, pre- and post-tests, interviews and surveys, and an analytic review of collaborative versus individual essays. To permit comparisons between the traditional approach to writing and the new one, participating faculty each taught two sections of the same course, one using computers and co-authoring and one using individual writing without computers.

Project Impact

The pre- and post-tests showed that the students in the experimental group improved much more than those in the control group, at least in the first year. The difference was statistically significant that year; in the second, the difference was insignificant.

Two other encouraging results surfaced. Even though experimental students were required to write less than the control students, they made greater or equal progress. Further, weak writers using co-authoring made greater progress than weak writers using traditional techniques.

In the essays themselves, the co-authoring writers demonstrated an ability to pursue alternative arguing strategies that was not present in the essays by individual writers. Students in the experimental sections even showed a certain continuity of learning from essay to essay, e.g., they occasionally drew from previously co-authored papers.

Participating faculty agreed that even though co-authoring students may not have always shown immediate improvement as individual writers, they did show dramatic gains as individual thinkers. As yet, however, this writing-thinking connection is not supported by any data other than faculty and consultant observations.

The survey results and individual student interviews strongly support the claim that this experiment improved student attitudes towards writing. Co-authoring students expressed significantly more positive attitudes not only towards writing, but also towards thinking and working harder, and towards defining themselves as writers.

According to students, the faculty of co-authoring sections were more valued as effective writing teachers. Students believed that they gave workable assignments, set fair goals and awarded fair grades. The faculty too responded very positively: the project, they claimed, caused them to enjoy reading and discussing drafts of student essays. In fact, post-test scores of faculty attitudes toward student drafting, composing and revising rose substantially. In the words of one instructor, "It felt good to no longer be a latecomer to the student's writing process, arriving in the margins of a text as red ink when there wasn't much point in arriving at all, except to put a grade on the paper. One of the principal goods of the academic life—intense and meaningful discussion of important issues—is taking place and being recorded."

Lessons Learned

- The hidden text feature of the co-authored essays offers a way around the often-heard concern from composition theorists about how to foster collaboration without compromising the rights of individual students. It allows free and easy communication about writing among students and instructors.

- Interdisciplinary programs usually require more institutional support than other efforts, and this one was no exception. It depended on the cooperation of a variety of departments across the College, their faculty and administrators, and in-house computer and technical staff. Obviously, this willingness to experiment and learn new pedagogy demanded much more from participants than continuing to teach in traditional ways.

- Large teaching loads and the need to cover certain material restrict faculty from making radical changes in their syllabi or writing assignments. An experiment like this one flourishes best within a context of overall curricular reform, or as a feature of an already established writing-across-the curriculum program.

- And, finally, just because a program tries to shift authority away from the teacher and place him or her into a more collaborative role doesn't mean that students recognize and accept the shift, or know how to fulfill their greater responsibilities.

Project Continuation

The college continues to fund the technology necessary to support the sophisticated co-authoring software used in the project, and has upgraded the computer network in the Academic Resource Center to make it easier for co-authors to access each other's texts. However, in recent years there has not been funding for the training necessary to introduce the project to new faculty. The project director, who left the college the year after the project ended, has instituted a modified version of the original project at Boston College.

Available Information

Information about the project is included within on-line discussions on Bitnet and/or may be obtained from the project director:

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The final report to FIPSE fully describes the project's evolution and implementation. The project director published one article and one book chapter based entirely on the FIPSE project:

"Collaboration: the Case for Co-Authored, Dialogic, Non-linear Texts" in Writing Relationships: What Really Happens in the Composition Classroom. Heinemann Boynton/Cook. 1993.

"Writing Between the Lines" in Vital Signs 2: Learning and Using Language Collaboratively. Ed. James Collins. Portsmouth, NH: Heinemann Boynton/Cook, 1.

UNIVERSITY OF DELAWARE

Computer Assisted Communication Within the Classroom—Interactive Learning

Purpose

Minds that drift away in class; post-exam revelations that many had not properly prepared for the test; unresolved questions and snowballing misunderstandings—the aim of this project was to eliminate these perennial obstacles to learning through a novel use of computers. The system, which enables students to respond to questions on individual keypads connected to the instructor's computer, was expected to allow students to follow step-by-step problem-solving procedures in an elementary astronomy course.

Innovative Features

The course is conducted in a classroom wired for student response/display pads which are connected to a central microcomputer operated by the instructor. Software includes the locally-written Response Acquisition Program, MicroSoft's Professional BASIC Compiler, and a spreadsheet (SuperCalc) for maintaining scores.

If students want to ask questions on the day's assigned reading, they enter the numbers of the pages where the material they do not understand is located, and the instructor answers the questions. If the instructor wants to ask the class questions, he presents them on an overhead projector. Students key in their responses, which may be numerical (e.g., 6.47×10^{-21}) multiple choice, yes/no or true/false. The responses appear on the instructor's screen and are automatically judged by the criteria entered into the computer program by the instructor prior to the class. A preprogrammed reply based on the student's response then appears on his or her keypad screen. Variable credit points may also be assigned to these responses.

Evaluation

Participating students were interviewed both individually and as a class, and they submitted formal, year-end anonymous evaluations and mid-semester written critiques. A pre-test was administered on the first day of each course as a measure of student preparation. This was supplemented with demographic information from admissions records.

Every keypad response for every student during a given semester was retained in computer retrievable form, along with student answers to written test questions. Written tests were comparable to those given in previous years.

Project Impact

There is no doubt that the project enhanced the instructor's ability to communicate with each student during a given class. This not only improved attendance and attentiveness, but for the most part, thanks to the interactive system's ability to break up problems into small steps, most students were able to progress together through complex problems.

On the whole, students reacted positively to the step-by-step mode of instruction that the keypads make possible. This was true even for the best students, who were aware that the class could have covered more material if the instructor had simply delivered traditional lectures which they would have had little difficulty following. Although most students liked the interactive format, however, data analysis so far shows that their performance improved only marginally.

Lessons Learned

Programming such a multi-step problem sequence originally took an inordinate amount of time on the instructor's part. Each step had to be carefully devised to eliminate ambiguities and stimulate thought. Answer judgments and replies had to be formulated, overhead materials prepared, and the entire system tested for errors. The time spent on preparation, presentation, post-editing, record-keeping and minimal evaluation for a single class could amount to several days.

However, with the massive collection of questions already programmed, class preparation time to include some keypad questions is minimized. The extra work (before and after class) can now add as little as an hour per class, much of it in record maintenance. For new questions, a computer program has been written to facilitate creation of the files that judge student responses. Enhanced student-teacher communication remains the primary benefit: the teacher knowing better the strengths and weaknesses of the class and the students knowing better what the teacher is expecting them to learn. Dealing with the emotional drawbacks that this knowledge can have for both teacher and students is an ongoing challenge.

Because of the broad range of abilities and preparation of students in introductory courses, some individuals are still unable to follow the process, no matter how thoroughly it is broken down. Thus, the pedagogical dilemma of how to challenge the best students while serving the needs of the less able ones becomes especially acute for the instructor in the interactive classroom. Thus far, students of poor background or ability are still not satisfactorily reached by the project.

Project Continuation

Demonstrations of the system, both on and off the Delaware campus, continue to be given. The optimum class size is about 30 students, since in larger classes the class time spent in awaiting student responses bores the better students while frustrating the slower ones.

The keypad system continues to be used regularly in Introductory Astronomy. Plans are underway to introduce the system into a large Physical Science course which is taught by group-learning methods. Each group will have a single keypad linked to the teacher's computer.

Available Information

Further information, including hardware and software requirements, is available from:

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WASHINGTON STATE UNIVERSITY

Enhancing Graduate and Undergraduate Training in Speech and Hearing Sciences

Purpose

Speech pathology students at both the undergraduate and graduate level have trouble relating the scientific principles that underlie their profession to the therapy they practice. This project created the software for microcomputer-based laboratory work and designed activities that allowed students to perceive and experience the relationship between scientific theory and therapeutic practice.

Innovative Features

The instructional modules and accompanying software are intended for graduate and undergraduate courses in speech science and for an undergraduate course in phonetics. Each student, at his or her own pace, completes the weekly computer laboratory assignment, which illustrates the week's lectures. Students manipulate the visual representation of the speech wave associated with various acoustical phenomena and hear the resulting effect. They are also able to break the speech wave into individual components. This simultaneous visual and auditory experience allows students to connect the problems they encounter in clinical situations with their scientific knowledge. It represents a significant departure from conventional practice because it gives students hands-on experience with acoustic phenomena, which increases their understanding of the separate systems in speech production, as well as their integrated nature.

Evaluation

Project staff measured the performance of students in the three courses on tests taken at the beginning and end of each semester, and before and after each laboratory exercise. Staff also compared overall learning gains and, in the case of the laboratory tests, specific gains in scientific knowledge. All scores in all three courses showed substantial and statistically significant learning gains.

Staff then compared scores on the end-of-course tests for the Washington State undergraduate students with those on the same test administered to students taking the same courses at St. Cloud State University. Students in the introductory speech science course at Washington State did significantly better than comparable students at St. Cloud ($t = 8.91$, $p < .05$), where the laboratory exercises were not used. The Washington State students also did better in the phonetics course, but the difference was not statistically significant. This result may in part be due to the fact that participation in the laboratory activities was optional in the phonetics course at Washington State, whereas it was required in the speech science courses.

Lessons Learned

The ability to manipulate visual representations of acoustic phenomena and to experience their auditory effect enhances students' scientific knowledge and renders them better able to link basic science with therapeutic practice.

In the course of the project, the director learned that students were most satisfied with the laboratories when the instructor was present to discuss issues as they performed the exercises. The project director also found that group activities requiring graduate students to explain real cases in terms of scientific principles helped to make the difficult connection between principle and practice. At the undergraduate level, audiotapes were used for similar purposes.

The number of graduate students electing to complete research projects involving acoustical measurement has increased markedly since the laboratories were introduced. The project director attributes this change to the laboratories' success in helping students overcome their fear of mathematics and "hard" science.

Project Continuation

The laboratories are now a permanent feature of the courses in which they were piloted. Laboratory materials, including software programs and documentation, have been distributed to the more than 100 speech sciences programs (out of 200 in North America) that requested them.

Available Information

Software programs and laboratory activities for the three courses, sound files and set-up files supporting those activities, and documentation of the software and laboratory tasks are available from:

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An article that arose from the project was published in 1995: Seikel, J.A., Drumright, D.G., Whites, M.M. & Seikel, P. J. (1995). "A "hands-on" approach to speech science." *Computers in Education*, 24 (2), 107-116.

CALIFORNIA STATE UNIVERSITY AT NORTHRIDGE
Effects of Assistive Technology on Postsecondary Students with Learning Disabilities

Purpose

Students with learning disabilities constitute the fastest growing group of disabled students on college campuses. Despite the remediation efforts of elementary and secondary schools, many of these students graduate from high school with learning disabilities largely unmitigated. Others, who have managed to compensate for their milder difficulties, often find their strategies hopelessly inadequate to the stringent demands of college. Most learning disabled students arrive on campus with bruised egos and a lifelong habit of avoiding certain activities, such as writing, that have proven especially arduous. The mandate to find effective and cost-efficient ways to help these students springs not only from the Rehabilitation Act and the Americans With Disabilities Act, but from every institution's responsibility to the students it accepts.

At California State University, Northridge, the Office of Disabled Students Services and the Computer Access Laboratory have a long history of collaboration in helping students to compensate for various disabilities and achieve academic success. This tradition of cooperation and compensation, added to the difficulties posed by remediation at the college level (it is too time-consuming and students find it humiliating), prompted the originators of this project to investigate the uses of computer technology in a compensatory rather than a remedial approach.

Many professionals who work with learning disabled students had long believed that technology could help these students with their reading and writing deficits. This project originated from the conviction that before the virtues of computer assistance to the learning disabled could be disseminated it was necessary to collect concrete evidence of their value.

Innovative Features

The project focused on three compensatory technologies:

- optical character recognition, which scans text from various sources such as books or handouts and converts it to a computer document;
- speech synthesis/screen review, which reads the computer document aloud using a synthesized voice while simultaneousy highlighting the words on the screen; and
- speech recognition, which converts words spoken into a microphone into a relatively error-free text displayed on the computer screen.

In the first year of the project, staff trained 80 students to use the equipment, and then evaluated their performance with technology assistance, with traditional assistance (readers and transcribers), and with no assistance. In the two following years they investigated the effects of the technology on long-term retention and success. In the third year the costs of the technology assistance were analyzed and compared to the cost of personnel-intensive assistance.

The first year's work revealed writing to be the area in which learning disabled students needed the most improvement. Project staff responded to this problem by creating two mini-courses, entitled "Passing the Upper Division Writing Exam Using Technology," and "Writing a Term Paper Using Technology." Over the next two years, the mini-courses were taught to sixty learning disabled students.

Evaluation and Project Impact

The **immediate** effects of the technology on reading and writing were tested as follows:

1. Effects of optical character recognition/speech synthesis on reading comprehension. Students read the Formal Reading Inventory—a series of successively more difficult paragraphs followed by comprehension questions—under three conditions: silently, with no assistance; having a human reader read the selection aloud; and using optical character recognition in conjunction with speech synthesis to scan and read the passages and questions.

The most deficient students performed better with the technology than with a human reader or with no assistance. The test showed that the more severe a student's deficiency, the more positive the technology's effects. In the case of more proficient readers, however, the technology interfered with comprehension. The investigators believe that converting text to auditory stimuli circumvents the decoding difficulties that severely learning disabled students exhibit.

2. Effects of speech synthesis/screen review on proofreading. Students wrote the first draft of an expository essay, then proofread their essay with each third of the piece being read under a different condition: with no assistance; having the section read aloud by a human reader; and using speech synthesis/screen review.

Students found more errors overall when using the technology than when listening to a human reader or when reading without assistance. The multisensory presentation may help students to perceive errors in a text.

3. Effects of speech recognition technology on written composition. Students composed three 500-word essays under the following conditions:

using speech recognition technology; dictating the essay to a transcriber; and with no assistance.

Under the "no assistance" and "transcriber" conditions, the distribution of scores of the learning disabled participants was significantly inferior to that of their non-disabled peers. When learning disabled students wrote with the help of speech recognition, however, their scores did not differ significantly from those of non-disabled students. Speech recognition allows students to produce text relatively free of the spelling and mechanical errors that often mar the writing of the learning disabled.

To gauge the **long-term** effects of assistive technology, the investigators surveyed the performance of students in classes with heavy reading and/or writing requirements. The grades of learning disabled students in these classes showed significant improvement, though not enough to raise the overall GPA significantly.

Assistive technology showed impressive effects on the performance of learning disabled students on the Upper Division Writing Proficiency Examination—95 percent passed, compared to 48 percent before the study, 52 percent for a matched group of learning disabled students who were not using the technology, and 75 percent for the non-disabled population.

Perhaps the most striking effect, however, was on retention: over three years, the drop-out rate for the 140 participants in the study was 1.4 percent, compared to 34 percent for the matched controls over the same period, and 48 percent for the non-disabled population over four years. Graduation rates also rose significantly for participants and differed significantly from those of their matched subjects.

Staff observations and questionnaire and test results testified to a growing independence on the part of students involved in the study—they relied less frequently on family, friends and services provided by the

University. As they became more comfortable with the technology they generalized its use to employment and recreation situations. Many participants came to terms with their disability, and showed a significant increase in leadership, initiative and academic interest. Generally, students attributed their improvements to the use of the computer.

To judge the cost effectiveness of the technology (exclusive of the mini-courses), two estimates were prepared: a bare bones estimate based on equipment purchase, training and maintenance; and a moderately enhanced estimate which included some outreach, needs assessment and provision for further training. Both estimates took into account the cost of increased computer use as revealed by the study. Both estimates were compared to the cost (including recruitment, training and salary) of providing comparable services by personnel such as transcribers and readers: savings per student per semester were $310 for the bare bones estimate, and $234 for the moderately enhanced version.

In summary: all three technologies significantly alleviated difficulties in reading comprehension, proofreading and written composition; significantly improved long-term academic retention and success; positively influenced academic behaviors and attitudes; and were highly cost effective compared to other interventions.

Lessons Learned

Despite the positive results of using computers for reading and writing, not all students were helped, nor was the technology equally useful for all tasks. The investigators conclude that technology assistance should be prescribed only after careful evaluation of the individual student's strengths and needs.

Recognition

The project yielded a number of articles in major journals, presentations at national and international conferences, and several national and international workshops sponsored by the University's Center on Disabilities.

Available Information

Further information on the project, as well as copies of related journal articles, may be obtained from:

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TEXAS COLLEGE OF OSTEOPATHIC MEDICINE
Expert Systems Shell-Based Programs for Medical Education

Purpose

Expertise in medical diagnosis takes a long time to develop. Medical educators would like to find ways to minimize that time so that doctors in the early stages of their residencies can approximate the knowledge of expert diagnosticians, and thereby reduce instances of misdiagnosis.

One possibility for attaining this goal lies in artificial intelligence (AI) and the expert systems derived from AI strategies. This project used an AI-derived tool (KBIT or Knowledge-Based Inference Tool) developed by one of the investigators to strengthen the diagnostic capabilities of medical students.

Innovative Features

Project staff began by determining the ability of the tool to make highly reliable and valid distinctions between the diagnoses of experts and novices. They were aware that the experts' success resulted from superior knowledge and experience rather than greater cognitive skills. They also found that successful diagnosticians are characterized by the ability to recognize patterns, to match symptoms with typical disease patterns and to discriminate among closely related patterns.

Through interviews with over a hundred expert practitioners in four medical problem areas (e.g., weakness, elevated creatinine) the investigators were able to extract the disease prototypes with which the experts were working and to represent the knowledge base and prototype through computer programs using the AI tool. They found that the programs produced highly reliable (.71 to .96, depending on the disease problem areas) distinctions between novice and expert diagnosticians.

Students, on the basis of their experience and knowledge, were required to compile profiles of each type of illness containing the signs and symptoms associated with them. These profiles were later compared for accuracy, pattern match and pattern discrimination with those developed by experts.

Staff then developed expert system programs that would allow the medical trainees to encounter the presenting symptoms in a large number of cases in specific problem areas. After arriving at a diagnosis, the students could compare their analytic processes with those of the experts, thus learning how the experts arrived at their diagnosis.

Evaluation

The work was evaluated in two stages. First, the ability of the AI tool to represent cases in such a way as to distinguish between novices and experts had to be demonstrated. This effort involved a statistical comparison of the diagnostic accuracy of experts and medical students when presented with information in this form.

Testing the value of the instructional approaches based on the AI tool required comparing the diagnostic results obtained by untrained students, by students trained conventionally, and by those trained using strategies derived from the tool. The results of these comparisons all demonstrated the validity of these expert systems programs in improving diagnostic training in particular diseases.

Project Impact

The AI students' levels of diagnostic accuracy were statistically superior to those of control or conventionally trained students. This project succeeded in creating problem-specific, computer-based instruments to improve the training of medical students in medical diagnosis. The construct validity of the KBIT and the decision making paradigm on which it is based apparently allow generalizability across medical problem areas. The KBIT thus has the potential to form a foundation for a new generation of educationally sound, "intelligent" instructional and assessment tools.

Lessons Learned

In designing these instruments it is important to define the problem in such a way as to allow for sufficiently fine discriminations. These discriminations include differences among varying levels of expertise (e.g., beginning vs. experienced residents) and differences between closely related diseases. Producing sufficiently fine-grained distinctions requires the patient development of large data bases.

A major difficulty for disseminating this educational strategy is the medical community's general lack of understanding of the theoretical bases of artificial intelligence. Thus medical educators are likely to resist these techniques until more of them understand how they work and the basis for their validity.

Project Continuation and Recognition

With the college's support, work continues on additional disease-specific areas. The project directors made a number of presentations and publications, and received the Thomas Hale Hamm New Investigator Award from the Research in Medical Education subgroup of the Association of American Medical Colleges.

Available Information

Information about the project, including additional unpublished materials, is available from:

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Integration of subject matters habitually taught in separate courses is one of the major strands of contemporary curricular reform. The teaching of basic skills "across the curriculum," widely implemented in writing instruction, has been extended to mathematics, foreign languages, and as two of this group of projects show, ethics. Whether working with beginning students in a broad range of fields (Community College of Aurora) or in a single professional program (University of Minnesota School of Nursing), faculty are discovering that practical ethics is best taught in context.

Kennesaw State College illustrates another kind of subject matter integration, the teaching of general education mathematics in the context of a familiar environmental problem. This same issue-oriented approach to teaching basic principles appears in the University of Oregon's biology course for non-majors.

THE COMMUNITY COLLEGE OF AURORA
Integrating Ethics Across the Curriculum

Purpose

For over a decade, ethics has been taught most commonly in business and medical schools and in the philosophy departments of colleges and universities. Today, with widespread abuses in many sectors of our society, there is growing interest in bringing ethics into other disciplines, as well as into different types of institutions and to different student populations. The purpose of this interdisciplinary project was to carry out just such curricular integration in a community college.

Innovative Features

Eighty-four Aurora faculty members in five groups attended seminars to learn how to integrate ethics across the entire college curriculum. These faculty represented 20 departments, and taught almost 2,000 students. In the first stage of the project, faculty studied the nature of ethics and its application to their disciplines, using a handbook prepared by the project director. In the later stages, they incorporated ethics into their courses.

This ambitious undertaking is especially remarkable in the context of a community college with a non-traditional student body. It grew out of a million dollar grant awarded in 1987 by the Colorado Commission on Higher Education to support the infusion of critical thinking into the College's coursework.

The ethics project had, from its beginning in 1989, the advantage of working with faculty and administrators already favorably disposed to instructional reform. Not only were the faculty committed to making their courses more relevant to the lives of their students, but their participation in faculty development activities was partly linked to salary increases.

The project was influenced by an earlier FIPSE grant to St. Cloud State University in Minnesota to increase the ethical sensitivity and social responsibility of students in professional programs. (See Lessons Learned II, available from FIPSE.)

Evaluation

Project staff evaluated the impact of the effort through the Defining Issues Test (DIT), faculty reports, and a survey of students. The DIT, developed by James Rest, measures the progress of moral growth from egoism to the adoption of moral principles.

Project Impact

Scores from pre- and post-DIT tests administered to students of faculty in all five groups showed an overall favorable shift, suggesting that the new ethics elements in the curriculum increased the capacity of students for principled, moral thinking. In the year-end reports of how they and their students were progressing with the integration of ethics into their courses, faculty stated that the integration improved students' ability to understand and apply ethics practically and theoretically.

Students' survey responses emphasized that integrated ethics courses had enriched and advanced their understanding of ethical issues in social and disciplinary contexts. Ninety-eight percent of students in three of the faculty groups believed that they had a better understanding of how to resolve ethical dilemmas. In all the groups there was some evidence that, by discussing discipline-specific ethical issues, students found new relevance in the academic material and even made connections to ethical issues in their other courses.

Lessons Learned

Despite the college's strong and continuing support for the project over the years, the director came to believe that ethics across the curriculum may be too diffuse to increase the social responsibility of students. He learned about research by Judith Boss at the University of Rhode Island in which she used the DIT in evaluating students in an ethics class with service learning compared to those in an ethics class without it. She found greater gains on the DIT in the class with service learning.

This result prompted the project director at Aurora to make the same experiment, with similar findings: community service seemed to draw students out of their relativism and egoism and give them a better grasp of the ethical dimensions of issues. He concluded that linking ethics and service learning and focusing on civic responsibility is the way to develop a sense of commitment to the public good. He addressed this problem by connecting the Ethics Across the Curriculum project to the Kellogg-funded Beacon Project, which emphasizes the ethical content of civic responsibility. In addition to their usual course work, students now explore civic responsibility issues by doing field work in the community.

Project Continuation and Recognition

Despite an added focus on civic responsibility through the Beacon Project, curricular integration of ethics remains a permanent part of the college's curriculum and teaching repertoire. Polls of past faculty participants show that all but two respondents are still implementing ethics in their courses, some noting that they have varied the way in which they teach it.

In 1992, the college sponsored a retreat on the project for representatives from 20 colleges and universities. The American Association of Community Colleges granted Aurora a Kellogg/Beacon award to assist six other community colleges in building interdisciplinary faculty development around the subject of civic responsibility. This involved faculty from FIPSE's ethics project in seminars and curricular work to integrate civic responsibility themes into courses and to assist the other colleges. This effort culminated in 1993 as all participants came together at the College's yearly International Faculty Development Conference. Finally, this Beacon Project contributed to the American Association of Community Colleges receiving a major Learn and Serve grant to promote service learning among ten community colleges in 1994.

Available Information

Faculty on the ethics integration project have given countless presentations at major disciplinary meetings, retreats and workshops, at professional associations and for community organizations. They have published a variety of articles on the moral dimensions of teaching. The director wrote a Participant's Handbook for Integrating Ethics into the Curriculum as the primary text to guide faculty in curriculum development and, in 1996, published a book, The Curricular Integration of Ethics, with Praeger Publishing Company. He also is co-editor of Promoting Community Renewal Through Civic Literacy and Service Learning, to appear in the 1996 Jossey Bass New Directions Series, and of Service Learning and Philosophy, to be published by the American Association of Higher Education in 1997.

Information regarding these materials may be obtained from:

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UNIVERSITY OF MINNESOTA
Ethics Education for Baccalaureate Nursing Students—Multi-Course Sequential Learning

Purpose

This project designed and implemented ethics education for undergraduate nursing students. The educational experience, designed as a single course, consists of a number of modules that can be integrated into several courses, both classroom and clinical, throughout the undergraduate curriculum. In the process of creating these modules, the university's nursing faculty enhanced their ability to help students to apply ethical principles in practice. The initial grant and a subsequent dissemination grant served a third audience of nursing educators in the U.S. and Canada by making course materials and teaching strategies widely available.

Innovative Features

The embedding of modules and activities, structured to constitute a single, integrated course, into several separate courses represents a new way of providing ethics education for nurses. This strategy solves the problem of how to give the teaching of ethics identifiable curricular space, but it also allows students to consider ethical issues at all stages of their program and in both classroom and clinical settings. Ethical considerations are thus kept constantly before the students, who are able to address them with increasing sophistication as they mature in their educational experience. Students receive a grade for a single course at the end of the program.

The units are included in thirteen required courses, eight didactic and five clinical. Workshops at the beginning of each of the first two years of the project helped faculty to become more proficient in dealing with ethics issues and the strategies and mechanics for integrating the ethics units into their courses. The ethics faculty designed learning objectives and teaching strategies for each unit, and evaluated most of the student work. The only material not graded by the ethics faculty was the ethics section that most of the clinical teams added to the care plans or journals required of students in clinical courses.

Student learning was evaluated in multiple ways, including questions on take-home exams, multiple-choice questions in course exams, a term paper, a written small group exercise and a graded group presentation. During the period of project funding students received an integrated report of their performance in all the course modules.

Evaluation

Students also completed the Defining Issues Test (DIT) developed by James Rest, whose work formed the conceptual base for the program. The instrument was administered both before students began the program and after its completion. As an effort to establish a control group, the last class admitted before the new program was initiated was also tested, although they went through their undergraduate experience in an atmosphere strongly influenced by the strategy of spreading the ethics instruction over several courses.

The attitudes of faculty toward the new materials and instructional strategies and the reception of the dissemination audiences were evaluated through questionnaires.

Project Impact

On work evaluated by the ethics faculty and involving multiple readings of discursive responses, most students received grades in the A or B range, with a minority of C's and a very few lower grades. Thus, in the eyes of those who established course goals, student performance was quite good.

All student groups, except for one whose circumstances of admission and rate of persistence were anomalous, showed significant improvements in their scores on the Defining Issues Test. However, the patterns of difference in performance on the DIT among the three treatment groups and between those groups and the control group show no consistencies that suggest that the gains are attributable to the revised strategy of ethics instruction. It is impossible to know the degree to which those gains are attributable to the ethics course, as opposed to the curriculum in general or to greater maturity. It seems reasonable to conclude, however, on the basis of other research, that an environment in which ethical and moral issues are continuously raised fosters moral development.

Evaluative research on the project does show a strong positive influence of moral reasoning ability on clinical performance. Stepwise regression analysis showed that scores on the Defining Issues Test accounted for as much as 34 percent of the variance in scores on a faculty-developed Clinical Evaluation Tool, which provided a standardized rating of student performance in clinical situations.

Questionnaires indicated that the faculty were satisfied with the workshops. By the end of the funding period, 87 percent agreed that their teaching had been influenced by the project and 86 percent felt that it had affected their own nursing practice. Their collective estimate of impact on students, on a seven point scale, was 5.8 for ethical sensitivity, with lower but still positive estimates of effect on reasoning, commitment and action.

Lessons Learned

Faculty resistance to taking classroom time to deal with ethical issues was perhaps less than might have been expected. Only four of the 16 faculty surveyed found the time commitment to these matters excessive.

Students, however, persisted in seeing the ethical models as add-ons to their courses, despite the fact that other course content had been reduced to accommodate the ethical issues. The persistence of this view may have arisen from a faculty attitude that the ethics units belonged to the ethics faculty rather than to the whole faculty. Some students also expressed concern about the episodic nature of the ethics units, preferring a complete course devoted to those issues. Project directors had to work hard to retain those parts of courses which it had originally been agreed would be devoted to ethical issues. This problem was partly a matter of instructor turnover and the need to work with teachers who had not been party to the original agreements.

Project Continuation and Recognition

The multi-course sequential strategy has become an established part of the University of Minnesota School of Nursing curriculum. The model has proven adaptable to the program reorganization that resulted from students being admitted to the program at the junior rather than the sophomore level. Research on project effects and program dissemination activities continues. The project has reached several external audiences. A national conference on the topic "The Care-Justice Puzzle: Education for Ethical Nursing Practice" drew 145 participants. The attendees, plus others who requested it, received the 200-page handbook of instructional modules and teaching strategies developed during the project. Three workshops involving ten institutions, six of them in Alberta, Canada, were enthusiastically evaluated.

Available Information

Various aspects of the program have been described in six published articles, four of them in the Journal of Nursing Education. Copies of the project handbook and information about the curriculum are available from:

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KENNESAW STATE COLLEGE
Earth Algebra

Purpose

The project directors, given the charge to "do something about College Algebra," were inspired by a colleague's observation that "if you want to make a course interesting, you should study something of interest." The result was Earth Algebra, a course with an accompanying text that teaches the customary content of college algebra entirely in the context of the problem of global warming.

The course and the text place particular emphasis on the practicality of mathematics, focusing on problem solving, interpretation of results, and decision making that uses mathematical modeling. Students use graphing calculators and practice writing and reporting orally on results. Earth Algebra covers functions, matrices, geometric series, linear programming, and linear, quadratic, exponential and logarithmic equations and functions.

Innovative Features

Faculty chose global warming as the topic of the course because questions related to it lend themselves so well to definition and analysis using the traditional subject matter of college algebra. In addition, global warming is an issue with which students may be supposed to have at least superficial familiarity, and which is of intrinsic interest to many.

Using this kind of subject answers the questions that students uninterested in mathematics ask about these required courses: "Who cares?" and "What is this stuff good for?" It also provides occasion for problem solving and decision making that students find meaningful.

Evaluation

The results of the course have been rigorously evaluated using pretest/post-test techniques that measure student gains on knowledge of algebra, data analysis, mathematical modeling and attitude toward mathematics. Students registering for College Algebra did not know that Earth Algebra was being offered until their first class. Thus assignment to treatment (149 students) or control group (181 students) was random, except for the possibility that an undeterminable number of students deliberately changed sections during the drop/add period. A pretest was administered about a month after the beginning of the course and a post-test eight weeks later. The evaluator was not connected with the project.

Project Impact

Scores on two different mathematical skills tests were not significantly different for students in the Earth Algebra sections and those in the regular sections. This result is notable since the Earth Algebra course did not put as much stress on certain topics as the standard course.

More significantly, participants in the Earth Algebra sections showed twice the gains of those in regular sections in data analysis and mathematical modeling, which were tested separately from the other skills. Since gaining a sense of these more conceptual uses of mathematics (as opposed to solving problems) is more appropriate for students who, unlike majors, will take no further courses on this subject, this result is particularly important.

The gain of Earth Algebra students in favorable response to mathematics and appreciation of its conceptual power was nearly eight times that of the control group. Apparently, by studying mathematics in a context of meaningful applications and discovering that they could indeed "do math," students lost many of their prejudices and misconceptions, whereas their peers in regular sections emerged with attitudes very little changed from those with which they began.

Lessons Learned

The Earth Algebra approach seems to enable students to gain as much in mathematical knowledge as a conventional course, but works significantly better at enhancing awareness of the conceptual power of mathematics and favorably affecting students' attitudes toward the discipline. As such, it serves the purposes of general education as well as preparing students for a next course in "business" calculus or statistics. At some institutions, Earth Algebra cannot be used to prepare students for a standard calculus course without supplementary material.

Analyses undertaken as part of the evaluation revealed some interesting correlations between course grades and performance on certain evaluation instruments. Improvement in attitudes toward mathematics proved a statistically significant predictor of the final course grade. Gains in data analysis also appeared a good predictor, but not at the level of statistical significance.

In summary, the Earth Algebra project demonstrated the possibility of teaching college algebra to a reluctant audience while increasing their conceptual abilities and appreciation for mathematics, and producing fewer course failures and dropouts.

Project Continuation and Recognition

The appeal of the instructional strategy and its success in action have had a wide-ranging impact outside the college. The text for the course, published by HarperCollins, has been adopted by approximately 100 institutions. The project directors have given numerous presentations, workshops and minicourses on their work at regional and national conferences and individual colleges and universities. Earth Algebra was featured in the nationally broadcast Paul Harvey radio program.

The project directors have a new FIPSE grant to develop and test individual modules that can be used in a wider range of courses, especially teacher education and precalculus courses. These so-called Earth Math materials will also have specific relevance to courses for preservice teachers. Seven institutions will join Kennesaw State in planning and testing.

Available Information

Earth Algebra: College Algebra with Applications to Environmental Issues, by Christopher Schaufele and Nancy Zumoff, was published in a preliminary edition by HarperCollins in January, 1992. The first edition was published in January, 1993.

Information about project results and on-going work may be obtained from:

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UNIVERSITY OF OREGON

Workshop Biology for Non-Majors—Promoting Scientific Literacy Through Investigative Laboratories and Issue-Oriented Activities

Purpose

It's winter term at the University of Oregon, and the students in introductory biology are about to learn the anatomy of the heart.

In one laboratory, the instructor draws diagrams of the heart on the board, labels each part with its anatomical name, and explains exactly how the dissection should proceed. Students copy the drawings and learn the terms and then begin the actual dissection.

In the Workshop Biology laboratory across the hall, students are handed sheep hearts and dissection tools. Guided only by a handout that asks a series of leading questions, students attempt to figure out the function of the different areas of the heart and the path of blood flow from what they see on their dissection trays. They make their own diagrams and record their observations. As the students discuss their findings, the instructor introduces key terms but only where necessary to facilitate understanding.

By the end of the session the class has inferred the "double-loop" blood flow—a concept new to most students—and has grasped the basic form and function of the heart. In addition, despite their initial fears about going into the laboratory "cold," students have learned an important lesson in making observations and inferences, and gained insight into the workings of the scientific method.

Workshop Biology, a three-term laboratory-based introductory sequence, seeks to improve science literacy among non-science majors. In the context of this project, "science literacy" means the individual's ability to make informed, critical decisions, consistent with his or her values, on science-related issues. The course acquaints students with scientific inquiry, critical thinking and decision-making, and the relationship of scientific knowledge to social issues.

The belief that new roles for the students imply new roles for the faculty is fundamental to this project. Accordingly, as the course was being designed and taught project staff worked to foster a "teaching culture" in the department.

Innovative Features

Whereas traditional instruction focuses on increasing knowledge, the goal of Workshop Biology—to help students make decisions on science-related matters—requires that attention be paid to their background knowledge and ways of learning, their thinking skills and their values.

Workshop Biology reverses the proportions of laboratory and lecture time, so that students spend only an hour and a half each week in lecture, and four hours per week in the laboratory. Instruction centers on open-ended, investigative activities for relatively small groups. Each term, laboratories revolve around one of two general "workshop" themes such as human genetics or the biology of cancer. Students choose one workshop or the other at the beginning of the term.

Lectures are replaced by "assemblies," which all students attend together. Assemblies include special presentations and small group activities, and give students the opportunity to generalize abstract concepts from their concrete workshop experiences, to link important ideas, and to discuss the implications of their knowledge.

Workshops and assemblies consist of three kinds of activities:

1. Concept activities, which teach the key concepts of biology through discovery and hypothesis-testing exercises (i.e., the heart dissection described above). These activities are often designed to confront the fundamental misconceptions about the natural world that many students share.

2. Investigative activities, which emphasize the skills and attitudes necessary for scientific inquiry and an understanding of current scientific controversies. Students design, conduct, and evaluate studies, and present their findings in writing.

3. Issue-oriented activities, which require students to use scientific concepts, reasoning, and awareness of their own values to confront personal and social issues. Students address topics such as pesticide regulation, forest management or genetic engineering through library research, group discussion, writing, poster sessions and class presentations. As their projects evolve, students maintain a constant dialogue with their instructor by handing in a series of outlines, rough drafts, problem statements and bibliographies for the instructor's comments.

In addition to the course materials, project staff developed four software modules, interactive simulations that allow students to correct their misconceptions and design their own investigations of phenomena and their impact on society. The simulation entitled Demography, for example, not only helps students to investigate the relationships between age structure, birth and death rates, and population growth, but stimulates them to reflect on major current social issues.

The magnitude of these pedagogical reforms has necessarily had as much impact on faculty as on students. The Workshop Biology model, the creators felt from the beginning, should obtain for instructors too. They needed to reflect on epistemology, values, and critical thinking. They had to be as free as their students to question, take risks, and obtain feedback. Workshop Biology could succeed only if faculty were immersed in a teaching culture.

Frequent contact among project staff was essential to the project. During the first two years, all faculty and teaching assistants involved in the course met weekly. Eventually, electronic communication became a practical means of communication as well as record-keeping.

In the third year of the project, the weekly meetings led to the formation of a "Science Education Journal Club," in which project staff as well as faculty and graduate students from biology, chemistry, English, philosophy and other programs discuss current research in science education, collaborative learning and writing across the curriculum.

Furthermore, to document teaching and professional development project faculty instituted teaching portfolios, which include annotated syllabi and handouts, student feedback, classroom research, and reflective writing. Most of this work is available electronically.

Evaluation

Course evaluation techniques included pre- and post-tests of concepts, reasoning skills, values, and attitudes towards science; frequent student evaluation of course activities and goals; analysis of student work; classroom observation; and tracking of enrollment and demographics. Students in the traditional introductory biology course were used as a comparison group throughout the project.

The four interactive software simulations are presently being beta-tested at a number of colleges, universities and secondary schools.

Project Impact

The comparative data gathering posed some inferential and logistic difficulties. By "triangulating" the results through gathering a variety of data and by constantly varying the "experiment," the project staff tried to build a persuasive body of evidence. The results varied as the project matured. Overall, in comparison to their peers in traditional introductory biology classes, Workshop Biology students:

- show greater improvement in conceptual learning and understanding of scientific reasoning. Women and non-traditional students display particularly high levels of learning and motivation, and non-native English speakers do not seem to be at a disadvantage.

- develop a greater understanding of and willingness to address complex issues. Students consistently cite the course's relevance as its most important aspect.

- become more involved in their learning experiences and value them more highly. As might be anticipated, these students expect more from the course, and offer unusually sophisticated critiques of its various components.

While the project staff have sufficient evidence to support these generalizations, they admit to limitations in interpreting these complex data. For detailed clarification of each research conclusion, consult their 1994 final report which is available from the project director.

In practice, the laboratory-intensive format of Workshop Biology turned out to be less important than the structure of activities themselves. Using lessons learned in the first three years, the project is now getting similar (sometimes better) results in a less resource-intensive, more sustainable course format. Workshop Biology now meets for 90 minutes on

Tuesdays and Thursdays in a large-lecture setting, and for 90 minutes on Wednesdays in the laboratory. This has allowed the instructors to use lecture time to plan and discuss laboratory activities, so that the laboratory is still the focal point of the course. For example, on Tuesdays students can work on formulating a hypothesis or carrying out a conceptual activity to prepare for Wednesday's laboratory session. Then, on Thursdays, they can discuss the laboratory's results and use that as a basis for a larger discussion of concepts and issues. Many conceptual and critical thinking activities have adapted well to the large-lecture setting, and still allow students to work in small groups.

Beyond the classroom, the efforts to maintain the teaching culture continue: faculty meet in person regularly and confer electronically. Those who are not teaching Workshop Biology observe classes and provide feedback. The Science Education Journal Club continues to attract faculty and graduate students from a number of disciplines.

The issues-oriented activities using posters are currently being adapted and used by more biology faculty at other institutions than any other workshop activity. They are flexible, require no special resources, and seem to fill a gap in most introductory biology curricula—the need for relevance and a focus on critical thinking. Poster sessions are also an effective dissemination tool in their own right; sessions are held in the main atrium of the science complex and are visible to other faculty, who are stimulated to try them. Posters are now used frequently in other biology courses and in other departments, most recently in introductory psychology and education courses.

Lessons Learned

Project staff feel strongly that continuing assessment of Workshop Biology is imperative. Like the student who wrote "the major thing I have learned in this class has been that questions are O.K. without answers, that questions are the most important thing," faculty believe that it is less important to aim for a perfect course than to ask the right questions as the teaching process itself evolves to adjust to the changing needs of students. Assessment and collaboration on its design and interpretation make the teaching culture possible—a culture in which teaching presents an intellectual challenge similar to that of disciplinary research.

Workshop Biology has revealed that inquiry-based learning can teach content better than can traditional, transmission-oriented activities such as lectures. Initial expectations were that Workshop Biology students would gain more than their traditionally taught peers in the areas of investigative and critical thinking skills, and attitudes toward science. Project faculty hoped that they would not fall behind in content learned. In fact, the most dramatic results achieved in Workshop Biology are content-oriented—not that students have memorized more facts or learned a broader range of content, but they have a better understanding of fundamental concepts that they can use effectively in new situations. Some science instructors assume that inquiry-based activities can motivate students and help them learn about the process of science, but that in order to learn content students must be talked at. An even more common assumption is that students must learn some content before they can participate in inquiry. Project results provide evidence that neither of these assumptions is true.

All college teachers are familiar with students who think they know more than they do. The staff has encountered the opposite problem: project students do not realize how much they have learned. When learning outcomes are unfamiliar, students may not value them, and in fact may not recognize them. Project students often complained that they "weren't learning anything," which, upon probing, turned out to mean they were not memorizing facts. Frequent reflective writing and self-evaluation helps students to recognize and value other kinds of learning. This, in turn, helps their performance on unfamiliar kinds of exercises and assessments, which reinforces the fact that they are, indeed, learning something.

Project Continuation and Recognition

Workshop Biology continues to be offered and assessed. Its pedagogy has influenced teaching in many courses throughout the department, and has led to the implementation of a similar project for majors, funded by the Howard Hughes Medical Institute. The assessment principles and methods developed for this project are now in use at several other institutions, and staff frequently consult on other curriculum development projects, including those of FIPSE and NSF. Assistance with assessment and the process of continuous improvement has proven to be the area of greatest need among dissemination participants.

In 1994 the project received a new Comprehensive Program award from FIPSE to disseminate Workshop Biology, and now has also been funded by the National Science Foundation.

Available Information

A Workshop Biology curriculum handbook is now available. It includes laboratory activities with instructor notes and student handouts, a manual for designing issues projects, a guide to assessment and course improvement strategies (including assessment instruments) and several bibliographies of useful resources, in addition to discussion of Workshop Biology philosophy and goals. This set of materials is available from the project staff in hard copy, on disk, or can be downloaded from a WWW site:

http://Biology.uorgon.edu/Biology_WWW/Workshop_Biol/WB.html

Project staff now publish a quarterly newsletter on college biology teaching, *Biology Education Review*, available in hard copy and on the WWW. (It can be accessed from the home page listed above.)

Additional information about the project may be obtained from:

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ASSESSMENT

Under increasing pressure from the public, state legislatures and regional accrediting agencies, colleges and universities have expanded their efforts to assess the academic achievement of their students. Earlier volumes of Lessons Learned focused heavily on national and state attempts to promote assessment and support the development of principles and technology for carrying it out. .The demand that regional accrediting agencies give more attention to the educational outcomes of the institutions with which they work has led nearly all of them to require substantial assessment activities on the campuses under their jurisdiction. A recent study by the Hudson Institute assessing assessment at a sample of higher education institutions found that 90 percent claimed some type of assessment activities on their campuses. At the same time, it found that the actual detailed attention given to academic assessment was surprisingly slight, considering all the external pressures placed on these institutions for self-evaluation. Even though assessment experts have criticized the research methodology of this study, they generally do not dispute these conclusions.

While the highly useful activities of groups like the American Association of Higher Education (AAHE) or the South Carolina Higher Education Assessment Network continue undiminished, at present the responsibility for innovation is firmly fixed on individual campuses and, indeed, on individual departments.

The influence of this trend in assessment is visible in the projects described here. The Miami (OH) University project uses portfolio assessment, a popular strategy, to evaluate writing skills, while the University of Wisconsin Medical School experiments with assessment based on observation of student behavior in clinical situations.

The more broadly based, general education assessment project at the University of Connecticut was led by a former director of the AAHE Assessment Forum. It pulls together much of the accumulated understanding, both educational and technical, of the assessment movement in an effort that is second generation in its carefully formulated statement of goals, clear relationship between goals and evidence of their achievement, and multiplicity of assessment strategies.

The work of the Mathematical Association of America has more to do with assessment for placement purposes, but its success has implications for uses of technology in outcomes assessment and the possibility of developing widely accepted standards for judging outcomes.

UNIVERSITY OF CONNECTICUT

Assessing General Education Outcomes— An Institution-Specific Approach

Purpose

There is much discussion and bewilderment in higher education about how to measure curriculum improvement, especially in general education. The University of Connecticut embarked on an ambitious project to test student performance in each of their six general education areas: science and technology, foreign languages, culture and modern society, philosophy and ethical analysis, social science and comparative analysis, and literature and the arts.

The university wanted answers to questions about whether a student's level of performance in the new general education curriculum improves with time in the program, and whether the number of courses taken in a general education area affects student performance.

Innovative Features

Just a few years after the general education curriculum was installed, the university set out to study its benefits to students and to further refine its goals, structure and course content. From the beginning, this three-year project was viewed not as a one-time activity, but as a continuing faculty-directed process of goal and curriculum improvement. Since the university had no prior institutional structure for assessment, the project required the creation of an ad hoc committee on assessment within the Faculty Senate.

Evaluation

The assessment process stressed the faculty's role in generating clear and concrete general education goals and in deciding what constitutes evidence that they have been achieved. Fifty faculty members working in six different goal committees (each of which included a behavioral measurement expert) examined all the course syllabi and relevant standardized and commercial tests, and arrived at a set of 14 locally-developed assessment instruments that matched the new goals. With two exceptions, each general education area was assigned two forms with complementary content. Another instrument, the Cornell Test, was purchased to measure critical thinking skills.

The major questions that these activities raised involved the validity of individual close-ended test items and the grading reliability of open-ended items. In the first data collection phase, project staff pilot-tested the assessment instruments on 1694 incoming freshmen (almost the entire class) and on 601 randomly-selected upper division students, and ran a series of videotaped focus groups with a much smaller number of students. Another 724 students were queried as to how they perceived their academic performance in the general education areas. Beyond this, staff surveyed 676 faculty on their level of agreement with the general education goals.

To test the effectiveness of the general education curriculum, statistical controls were used for general ability levels, maturation, attrition, and overall performance in non-general education courses. These controls factored out potentially contaminating effects from the actual effects of the curriculum. Multiple regression models were constructed with SAT scores, semester standing and grade points in both general education courses and non-general education courses as predictors of student performance on the assessment instruments.

Staff distributed summary findings to the six general education committees and to department heads, and these findings were discussed at special evaluation meetings. The faculty committees were charged with converting the results into recommendations for modifying or creating courses. Project personnel formally presented key results to the University's top administrators for their reactions.

Project Impact

The accumulated testing data from 4500 students showed gains in student performance as they moved through the university, even when controlling for differences in initial abilities (as measured by SAT scores) and the attrition of poorer students. Averaging across all general education areas, upper division students scored significantly higher (53 percent) than did freshmen (45 percent). The better performance of upper division students was statistically significant in five of the six general education areas, the exception being Philosophy and Ethical Analysis. The cumulative number of general education courses taken also produced a modest effect on student performance. After SAT verbal scores, one of the strongest predictors of performance on the tests was the grade point the students earned in general education courses.

Project faculty concluded that the general education curriculum, as a whole, has a modest but positive effect on student performance. Results of the faculty survey showed that the general education goals were essentially noncontroversial, as opposed to the means of implementing and assessing them. Despite the breadth of liberal arts goals, student opinion about the worth of general education commonly noted its practical and potential value to their future work, to selecting a major, and to learning writing and language skills. Students generally held positive views about their general education skills, and felt most competent in social science courses and least competent in philosophy.

Lessons Learned

Some unexpected experiences during the project shed light on faculty reactions and institutional readiness for assessment. According to one of the project directors, the process was an eye-opener for many faculty participants. Not only were they asked to look at courses in their category in relation to a set of "student goals" that they barely knew existed, but they were also supposed to look for commonalities *across* the courses within a given category — a daunting task for faculty who had seldom thought beyond individual courses. It was news enough to realize that there were even supposed to *be* these connections, never mind finding and describing them, and then building an assessment instrument around them.

The project directors believe that the project disproved the commonplace assumption that assessment cannot work in large research universities, and can only be effective in small liberal arts colleges with well-defined goals. In fact, they found that, certain characteristics of their university worked *for* assessment since it was possible, in a place as large as UConn, to find many individuals with both a strong research interest and a genuine involvement in teaching and learning, people who hungered for a project that legitimized their concern for students.

Project Continuation and Recognition

The university administration, under a resolution of the Faculty Senate, decided to continue funding assessment of general education and instrument revision through the Provost's Office. The newly-formed University Committee on Assessment continues to coordinate work in this area. The section of the university's five-year assessment plan describing the FIPSE project was singled out for high praise by the Connecticut Board of Governors for Higher Education. Staff have made presentations to the full University Senate, the University Dean's Council and all academic department heads. At least 50 requests from colleges and universities for summary reports and assessment instruments have been filled.

Available Information

Further information about this project may be obtained from:

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MIAMI UNIVERSITY
Portfolio Writing Assessment in Student Placement

Purpose

In recent years, testing student achievement has dominated the field of educational assessment, and this has raised fundamental questions about test validity and reliability. As the directors of this project note, there has been a continuing tension between the need to examine students' writing for placement and achievement, and the faculty's dissatisfaction with the means of doing so.

Miami University responded to this problem by becoming the first in the nation to explore portfolio assessment as a means of placing students in freshman composition courses. The portfolio method replaced standardized tests that did not judge actual writing, and one-shot, timed proficiency essays whose evaluation raised continual questions of accuracy and bias. Miami argued that a single piece of writing, produced under test conditions, has questionable content validity since the writing behaviors demonstrated in one essay do not constitute a representative sample of such behaviors. To enhance validity in assessing student writers, multiple pieces of writing composed at different times have to be considered.

Innovative Features

Miami embarked on its groundbreaking work by heeding the shift in composition instruction from transmitting knowledge about good writing to having students draft and revise. The project tackled hitherto unexplored questions of how portfolio assessment compares to holistic assessment of single essays, and how the gender of writer affects ratings. In addition, the reflective letter that students write to introduce the portfolio has brought forth a rich source of data for interpretation.

Several members of Miami's English Department consulted with local high school English teachers to develop an experimental portfolio program that would attract student participation. The Miami Admissions Office supplied listings of all freshmen and high school students likely to attend the University. Project staff designed guidelines for portfolio submissions and rating criteria, and trained portfolio raters. Staff then invited students to assemble their own portfolios, processed and scored them, and selected outstanding examples for new students to use as models.

Evaluation

Staff compared the new portfolio method to the traditional testing procedure by awarding placement and college credit to students admitted through the portfolio method while continuing to administer proficiency essays. The relative merits of the two measures were studied by tracking selected students who had been placed in courses based on either a high score on their portfolio and a low score on their proficiency essay, or a low score on their portfolio and a high score on their proficiency essay. Experienced raters scored these students' written work to learn which method better predicted student performance. In addition, to learn more about the strengths and weaknesses of the new method, staff collected self-report data from participating students, teachers and raters.

Project Impact

In a remarkable show of consensus and risk-taking, the Department of English voted to replace the proficiency essays with the new portfolios for the purpose of awarding advanced placement and credit. Consequently, data on participation from 1990 to 1992 showed an increase in the number of students submitting portfolios from 277 to 465.

In the first transitional year, students could achieve advanced placement and credit either by submitting a portfolio or by writing the proficiency essay, both of which were scored on a 1-6 scale. Eighty-five and a half percent of first and second readers of the essays recorded scores no more than one point different from one another, while 85.8 percent of first and second readers of portfolios recorded scores no more than one point different from one another. Thus, reliability in portfolio rating compares favorably to reliability in single essay rating. In addition, the portfolio method enhanced validity, since judgments derived from multiple and diverse writing sources.

The portfolios were found to have great appeal for faculty and administrators alike. Surprisingly, when reading time and rater fatigue were measured for both the portfolios and the proficiency essay, it was the essay that elicited more comments about fatigue, even though it took on average only two or three minutes to read, compared to seven to ten minutes for each portfolio. Raters worried that reading the same topic essays for hours distorted their judgment and sense of fairness, but this was not the case when reading the variety of writings in the portfolios.

A follow-up survey of raters suggests that the student's reflective letter introducing the portfolio had a powerful and personalizing influence on the rating of the whole. In fact, raters found the letter to be the most revealing about student attitudes toward their own writing—"a fascinating range of boastfulness, self-effacement, wit, and rambling." Staff speculate that the reflective letter positively affects reliability because it establishes the authority of the writer early, and prepares the raters to score the remainder of the portfolio. What is known is that both male and female raters perceived female students as significantly more successful than males in writing these reflective letters. Additional study is needed since portfolios and gender issues were found to interact in complex and subtle ways.

Project Continuation and Recognition

Portfolio assessment of writing has been institutionalized by the English Department at Miami. To assure continuity in program activities, other members beyond the original staff were enlisted into a Portfolio Assessment Sub-Committee on Composition.

In the third year of the project, Miami held a conference on portfolio assessment attended by 400 participants, many of whom were high school teachers and researchers. Teacher interviews and reports of instructional activities suggest the portfolio method may have affected the quality of composition teaching and writing in Ohio high schools.

Other institutions, including the University of Michigan and the University of Mississippi, have consulted with Miami's staff and begun their own placement portfolio programs.

Available Information

Information about the project is available from:

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Besides the final report to FIPSE, the following project publications are available:

New Direction in Portfolio Assessment. Donald Daiker, Jeffrey Sommers, Gail Stygall, and Laurel Black, eds. Portsmouth, NH: Heinemann/Boynton-Cook. (With special chapters on gender: "Gendered Textuality", and "Writing Like a Woman and Being Rewarded For It? Gender, Assessment and Reflective Letters from Miami University's Student Portfolios").

"The Challenges of Rating Portfolios: What WPAs Can Expect." Jeffrey Sommers, Laurel Black, Donald Daiker, and Gail Stygall. WPA: Writing Program Administration. Vol. 17, Nos. 1-2 (Fall/Winter 1993).

Handbook for Portfolio Assessment: A Program for College Placement. Jeffrey Sommers, Laurel Black, Donald Daiker, and Gail Stygall. Oxford: Miami University, 1992 (or available through ERIC, Document #ED350616).

"Using a Writing Portfolio for Placement in College Composition," Jeffrey Sommers, Donald Daiker and D.J. Hammond. Notes from the National Testing Network in Writing. 10 (December 1991) 2-3.

UNIVERSITY OF WISCONSIN AT MADISON
An Ability-Based Assessment Program at the Medical School

Purpose

In recent years, dissatisfaction with conventional methods of certifying student competence, especially in medical education has grown. Faculty find that methods using primarily written and oral examinations assess only limited medical skills. They insist that students be helped to develop a core of behavior, in addition to a core of knowledge, in order to solve both common and unique clinical problems.

Innovative Features

Faculty of the Medical School at the University of Wisconsin decided that it no longer sufficed to infer ability to perform from a student's knowledge base alone. Accordingly, they proceeded to build an ability-based assessment system that would assess both knowing and doing. This outcome-based project expands on work at other medical schools by incorporating the cognitive and non-cognitive abilities needed by medical school graduates.

Project staff asked the residency program directors at the University Hospital and Clinics to identify nine generic abilities that they felt a medical graduate should possess to be admitted into residency training. These abilities included appraisal, analysis, assessing own and peer performance, self-directed learning, handling stress, completing tasks, communication (including listening, speaking, writing and reading), consideration of professional ethics in decision-making, and interpersonal skills. Then, approximately 80 faculty from the basic and clinical sciences agreed upon explicit criteria to be used in judging medical abilities of increasing levels of complexity throughout the curriculum.

Thus, not only did this major medical school put aside multiple-choice testing of students in favor of the more difficult task of directly assessing their abilities, but it created measures to systematically develop, reinforce, practice and assess these abilities in multiple contexts. This innovation required faculty to develop clinical vignettes (incidents) using standardized patients (actors) that would allow student responses to be observed. These vignettes provided both new learning experiences for medical students and an opportunity to evaluate teaching that had not existed before.

Three clinical departments—internal medicine, primary care, and ob/gyn—in addition to faculty in anesthesiology, psychiatry, ophthalmology and emergency medicine worked to design the ability-based assessment exercises. The departments of Internal Medicine and Family Practice assessed students' ability to perform at the conclusion of each clinical rotation. At least 50 faculty developed the clinical vignettes, while another 100 repeatedly assessed student performance in them.

One hundred forty-three medical students were assessed each year over a three-year period. In addition, pilot studies of 106 oncology students and 26 pediatric residents assessed their written and oral communication skills.

Evaluation

Students as well as faculty deemed the project worthwhile, an integral part of teaching and learning rather than a disruption of the process. The new assessment method produced a unique performance database about student achievement that complements the knowledge acquisition data regularly collected on students.

The performance-based assessment instrument—the Objective Structured Clinical Examination (OSCE)—required students in study groups first to complete pre-curriculum surveys and view three OSCE videos of resident/patient interview scenarios. Then, after the students finished the curriculum, they completed the post-curriculum survey and viewed the OSCE scenarios again. The control group completed the pre- and post-components without benefit of the program. The OSCE students consistently outscored the control students on the knowledge and patient interview questions in the new curriculum, but the differences between the two were not statistically significant.

Since the OSCE stresses what a student can do, it was possible to discriminate among competent and less competent students on appraisal, analysis, communication and interpersonal abilities. In the evaluation of students' oral skills in interviewing patients with neoplastic diseases, rarely measured in any medical courses, inter-rater reliability among examiners was high and allowed finer differentiations in students' ability levels than had been possible in the past.

The correlation between standardized patient ratings and faculty assessor ratings was found to be significant, as was the interrelation of separate abilities, e.g., between interpersonal skills and analysis skills during physical examinations. Even as relevant new competency areas were being judged for the first time, performance assessment pointed out the need for improvement—which traditional methods had failed to detect—in certain other areas.

Lessons Learned

Charting new territory can be challenging and exciting, but it can also be discouraging: ability-based assessment has not been readily adopted in programs of medical education, where persons without an M.D. find it difficult to exert influence. Most medical educators have not yet realized that unless new pedagogies (e.g., problem-based learning) are accompanied by assessment methods focusing on new outcomes, the competencies of students will not change. Slowly, more medical schools are using them, but certainly not the majority.

To succeed in this kind of endeavor, the director of this project advises developing support groups, both within and without the institution. It may be advisable to form a consortium of medical schools to develop and implement ability-based assessment.

Despite these obstacles, the project director concluded that feedback in relation to explicit assessment criteria aids student learning. And the faculty learned that assessing student performance gives them new insights into reforming the curriculum and their teaching.

Project Continuation

The project has been incorporated into the Medical School's educational plan, with its own evaluation design to monitor effectiveness. Work remains to be done on several related issues:

- The school as a whole needs to assess the generic abilities that it expects of its graduates, rather than leaving the task up to individual departments. Performance assessment exercises need to be developed for the basic science years of medical education and for additional clinical areas.
- These generic abilities should become the primary focus of all of the other educational activities in the medical school—the content taught, the teaching methods used, and the assessment of student competence.

Available Information

In addition to a final report to FIPSE, the project has produced at least four books, three articles and several handbooks and videotapes on ability-based assessment.

The project director will respond to written inquiries:

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MATHEMATICAL ASSOCIATION OF AMERICA
Software for Computer-Generated Math Placement Tests

Purpose

Mathematics departments across the country spend large amounts of time devising tests to ensure the proper placement of students in their courses. They must create multiple versions of a given test so that groups of students taking it at different times will have different problems to solve. Yet these examinations must parallel each other and the problems must be equivalent in difficulty.

As a service to its members, the Mathematics Association of America (MAA) creates examinations. The Association's Committee on Testing devotes a substantial amount of time to assembling sets of formulas or algorithms from each of which many parallel problems can then be generated. The equivalence of the resulting problems is based on the judgement of the item writers, but cannot be statistically established.

Project staff believed that much of this time would be saved if formulas were written in such a way that the problems could be generated by computer. Not only could the tests be assembled more readily, but faculty at individual institutions would, if they desired, be able to create their own tests from the computer's item bank. Furthermore, the parallelism of the items and the equivalence of the tests could be statistically established.

Innovative Features

Through this project the MAA created computer software that produces statistically parallel tests in arithmetic, two levels of algebra, trigonometry, and calculus readiness. (Statistical parallelism means no more than a one percent difference in results among multiple versions of the same test, i.e., a test made up of items generated from the same set of computer algorithms.)

The group did not have quite the same success with the equivalence of individual items, though in most cases only one of the items generated lay outside the range of equivalence, and could be eliminated.

With the addition of a feature that produces a balanced key (i.e., not too many correct answers in a row that correspond to the same letter on multiple choice items, and a balance within the examination among letters that correspond to the correct answer), tests designed to the specifications of individual users can be assembled in 5-15 minutes. Examinations with a large number of graphic items take somewhat longer. The multiple choice items that make up these examinations have an appropriate range of distractors and are graphically clear and attractive.

At present, the test must be delivered already printed up. However, project staff hopes to make possible computer delivery of the examinations to individual student test takers, with immediate feedback on test results. Staff are also at work on incorporating calculator-based items into tests.

Evaluation

The items were field-tested on student samples ranging from 264 to 584 for each type of test to determine test and item equivalence. For four of the five tests, the four different versions were equivalent within a range of three to four percent on a 100 point scale. Work will continue to reduce the seven percent variance on the fifth test.

The spread on individual items was much greater, sometimes as large as 40 percent. These variances were greater for the smaller sample sizes, suggesting that a larger sample size might reduce the range of variance.

Project Impact

The increased ease of test creation has allowed a substantial expansion of services, which now run in the range of 400 to 500 institutions.

These users have received versions of the same examination in whose statistically established comparability they can have confidence.

Lessons Learned

The wider variance in individual items generated from the same algorithm was not foreseen. Sample size may account for some of the variance, but the differences also raise interesting questions about whether students regard as comparable the same things that mathematicians do. Nevertheless, the project demonstrates that useful tests with multiple versions yielding comparable results can indeed be generated by computer. These tests can be created very quickly and made graphically attractive.

Project Continuation

Further work on the test items has improved the level of comparability for different versions of both the same test and individual items. Efforts continue to create calculator-based items that can be incorporated into the individual tests.

Available Information

The project's final report and/or the placement brochure describing the MAA placement Test Program may be obtained from:

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TEACHER EDUCATION

Only two of the six grantees in this group, Pace University and the University of Oregon, are collegiate teacher education programs, which points to the increasing role of non-collegiate institutions in efforts to support teaching. Two of the grantees (Lawrence Hall of Science and New York Hall of Science) are science museums, one working with uncertified pre-kindergarten program staff, and the other with college students considering careers in science or science teaching. A college of medicine (Baylor) trained elementary school teachers, while a non-profit organization (Center for Applied Linguistics), focused on teachers of teachers.

Three of these projects involve science education. Four were designed for in-service teachers and administrators, including, in one case, college faculty. Four projects continue to generate substantial funding, while a fifth was self-terminating.

While the projects described here are atypical of teacher education programs, they do suggest an increasing willingness among teachers and school systems to regard agencies other than colleges and universities as significant sources of the training that they need, especially in the sciences. Conversely, museums—in history and the arts as well as in the sciences—are taking their educational role one step further by bringing to teachers, both pre-service and in-service, the imaginative teaching techniques they have developed.

BAYLOR COLLEGE OF MEDICINE
Houston Elementary Science Alliance

Purpose

The Houston Elementary Science Alliance (HESA) sought to provide elementary school teachers with content and hands-on activities that would enable them to feel comfortable teaching science and passing on their training to colleagues.

The training involved two-person teams from eleven Houston-area elementary schools—over a hundred people in three years—in five Saturday workshops and an intensive six-week summer session. The sessions, conducted by university and secondary school science faculty, covered a full range of topics from physical and natural science. Teachers were instructed in the presentation of scientific concepts through hands-on exercises and classroom projects that use low cost, readily available materials. Each teacher developed a detailed action plan for using the new knowledge in the classroom. Teachers were also expected to pass on their training to colleagues in their schools.

Innovative Features

While training elementary teachers in hands-on science teaching techniques is a common undertaking, this project is unusual in its size and scope. It operates under the sponsorship of a prestigious science teaching institution and includes faculty from three research universities (Rice University and the University of Houston along with Baylor College of Medicine) and the Houston Museum of Natural Science, and involves secondary and elementary teachers. The program is remarkable in its length (180 hours) and in the wide range of its curriculum. It represents one of the earliest curricular reforms teaming teachers with disciplinary scientists.

HESA is designed to create an extensive "cascade" effect: learning passes from Alliance faculty to teachers who attend the workshops, to their colleagues in the schools and from them to all their students. Requiring that teachers participate in teams of two from each school provides for mutual support when they return to teaching. The likelihood that the learning will find its way into the classroom is further increased by requiring participants to complete an extensive action plan. The commitment of teachers to making three in-service presentations to their colleagues involves the entire faculty of their schools in improving science knowledge and pedagogy.

Evaluation

The knowledge gained by the participants was assessed through two standardized tests and an interview. A questionnaire allowing teachers to express their opinions about different aspects of the program and to report on the applicability of the workshop experience to their teaching permitted additional evaluation.

Project Impact

Teacher response to the program was overwhelmingly positive. Of the 38 participants in the last grant-sponsored offering of the course, 29 recommended it at the highest level, while only two indicated that they would not recommend it to their colleagues. The teachers were unanimous in believing that they would use both the content knowledge and the teaching strategies they had learned in the classroom. Nearly 90 percent expected that their colleagues would be responsive to their in-school presentations.

On a test of science knowledge administered before and after the training program, teachers in the most recent group showed an increase of more than 80 percent. On the basis of his classroom observation of a sample of these teachers, the evaluator concluded that all were employing the teaching strategies emphasized in the training program, in most cases fully and apparently successfully. The participating teachers held in-service sessions for their colleagues according to their commitments, but the results of these sessions were not tracked systematically.

Project Continuation and Recognition

One group of three HESA participants provided in-service programs for over 500 teachers in the Houston Unified School District. The successor projects to HESA have extended beyond the city of Houston to surrounding school systems as well as to schools in Dallas and San Antonio. The program continues with support from a variety of funding sources, including the National Science Foundation. The summer institute now focuses on integrating mathematics and technology into science instruction, and on helping teachers to react to new science education standards. The project currently involves teachers from 15 elementary schools in the Houston area, and promotes activities throughout the year to support systemic change in science education. The current project, the "Harris County Alliance for Science, Mathematics and Technology Education," is a three-year partnership of Baylor College of Medicine, the Harris County Department of Education and three school districts, and includes a year-round project called "Tackling the Tough-to-Teach Science Topics."

Available Information

Information about the Houston Elementary Science Alliance's programs and other educational outreach programs of the Baylor College of Medicine is available from:

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UNIVERSITY OF CALIFORNIA AT BERKELEY
LAWRENCE HALL OF SCIENCE
Enhancing Science and Mathematics Education for Child Care Providers and Preschool Teachers

Purpose

Child care providers and teachers of preschoolers often lack background in science, and do not know how to teach it to the children with whom they work. Lawrence Hall of Science staff, building on their own experience in conducting programs for very young children, designed this project for early childhood teachers and day care providers from low income and minority backgrounds. Through three one-credit community college courses and eight Saturday workshops teachers learn how to get their charges actively involved in science and mathematics, and receive guides and materials to use in their teaching. In the process the teachers themselves learn some science and increase their enthusiasm and comfort in teaching it.

Innovative Features

The project was carried out in cooperation with many organizations in the San Francisco Bay area, including several school systems, networks and advocacy groups for early childhood educators, Headstart programs and Hispanic-American groups. Forms of cooperation included providing publicity for the program and instructional sites, and translating materials into Spanish and disseminating them.

The credit courses of 18 clock hours each engage teachers in activiity based lessons in science, demonstrating and discussing ways to present the materials to young children. The courses also present the philosophy of this educational approach and general methods for implementing it. Participants attend without charge and receive a handbook, teaching guides for each of four activities, and classroom materials. They are expected to try at least two of the activities with their charges and to report results both in writing and in discussion with other students in the course.

For early childhood educators who cannot attend the multi-week courses, project staff present Saturday workshops consisting of three units from the course. The workshops are conducted at public child care centers and preschools that serve urban and minority children. During the FIPSE-funded period, a total of 245 teachers attended these sessions. Written feedback from participants in these workshops and in the longer courses was used to modify the teaching guides in both their English and Spanish versions.

Evaluation

Course participants completed brief comment cards at the end of each week's session to provide formative feedback. They also wrote comments on their success in using each of the activities with their groups of children, and responded to an end-of-course evaluation.

After administering a pre-course survey that showed the frequency with which teachers used science activities with their children, project staff surveyed teachers one and two years after completing the course to see what materials they were still using and how their attitudes toward teaching science had been affected by course participation. Through case studies conducted by the teachers with some of their children, project staff got a sense of the impact of the science units on the children's knowledge and attitudes.

Project Impact

Participants gave high ratings to the courses: no aspect of the experience received an average rating of less than 4.5 on a five point scale, and most average ratings were 4.9 to 5.0. Teacher comment cards showed particular enthusiasm for what the teachers themselves were learning and for the materials and methods with which course instructors provided them.

In the final course evaluation, 78 percent of the teachers reported teaching more science than before entering the project. Most reported a frequency of two to three times a week, whereas before the course began 70 percent had reported teaching science less than once or twice a month. Even a year or two after completion of the course, nearly all the teachers reported continuing to use the instructional units and materials (95 percent were still using all four units) and to teach science more frequently.

Considering that the participating teachers worked with an average of 15 students each, the project reached at least 1470 children. Teachers described observable attitude changes toward living creatures for at least three-fourths of their students, as well as improved vocabulary and level of questioning.

At the end of the course, 97 percent of the teachers reported higher confidence in their ability to teach science, and two-thirds thought their teaching techniques had improved. The one- and two-year followup surveys found literally all respondents feeling that their confidence in teaching science had continued to increase as a result of the course.

Lessons Learned

This project demonstrates the feasibility of enabling and encouraging those who work with pre-school children to introduce their charges to science. Since these workers often lack preparation in science, the enthusiasm with which this work has been received is all the more remarkable. The principles on which this project is based, the role played by a science museum, and the utility of the materials produced are widely applicable in group child care situations, both public and private.

Project Continuation and Recognition

The course continues to be offered through workshops at the local community colleges and at the Lawrence Hall of Science, with both teachers and parents participating. The teachers' guides have been published and are used in the courses.

Teachers who participated in the courses and workshops continue to share their learning with colleagues in both formal and informal ways. The project has been presented to early childhood educators and college faculty at many conferences, both in California and nationally. Project staff have developed a regional network of people and agencies interested in promoting pre-school science education.

Based on the curriculum developed for this project, a National Science Foundation grant is supporting longer courses designed for four-person teams of pre-school and kindergarten teachers representing area school systems.

Available Information

Curriculum materials and handbooks from this project, known as Pre-School Exploration for Adults, Children and Educators in Science (PEACHES), and the successor program, Great Expectations in Math and Science (GEMS), are available from:

Kimi Hosoume
Lawrence Hall of Science
University of California at Berkeley
Berkeley, CA 94720
510-642-9633

Inquiries about the project newsletter, curriculum materials, and the handbook for the GEMS project should be addressed to Bernadette Laraya, at 510-642-8963.

THE CENTER FOR APPLIED LINGUISTICS
Improving Elementary School Foreign Language Teacher Education

Purpose

In 1985, the North Carolina State Board of Education took action requiring the study of foreign languages in elementary schools from kindergarten on by 1993. This action required a rapid increase in the number of in-service and pre-service teachers prepared to teach foreign language to elementary school students. In order to achieve this, it was necessary to work with teacher educators to improve their knowledge of the theory and methods of elementary school foreign language teaching.

The Center for Applied Linguistics (CAL) collaborated with the North Carolina Department of Public Instruction to create and carry out a program of training for teacher educators at most of the public and private four-year colleges and universities in North Carolina. Foreign language teacher trainers had background and experience in teaching foreign language at the secondary level, but most did not have experience at the elementary level. Operating on the principle that teacher educators themselves need experience observing and teaching at the level for which they will be training others, the project paired thirteen teacher educators at nine institutions with thirteen experienced teachers of Foreign Language in the Elementary School (FLES).

Project activities included: 1) a four-day seminar attended by the teachers and teacher educators; 2) a series of observations by the teacher trainers in the FLES classes and the teaching of some lessons in those classes; 3) development of a model elementary foreign language teacher education curriculum; and 4) implementation of the curriculum in college and university methods courses. Eight additional teacher educators participated in a second phase of the project, so that a total of 21 faculty members were provided the knowledge and experience to enable them to work with teachers preparing to teach in FLES programs.

Innovative Features

Having the college and university faculty literally apprenticed with the elementary teachers created a relationship and dynamic that was new to both parties. Teachers and faculty participated in seminars and designed the curriculum on an equal footing. This fostered a collegiality among people at different levels of instruction that was a revelation and a pleasure to all.

Each of the teacher educators was preparing to instruct pre-service and in-service teachers in FLES techniques. The varied teaching backgrounds and levels of foreign language preparation from which the students in the FLES training activities would come created a special need for flexibility in program design. Some of the new FLES teachers had secondary certification in foreign language and would be adding elementary preparation to their certificates. Others had elementary teaching backgrounds and would be adding the foreign language components to their general elementary certificates.

Thus, the State Board requirement that all future foreign language teachers have K-12 preparation meant that since a single-model methods course could not fit all the different situations, the model curriculum was defined in terms of the outcomes it was expected to produce. Each college and university program could then structure its program to incorporate all the necessary components in whatever courses were appropriate or for whatever preparation future FLES teachers might bring to a particular course. The classroom observations and teaching of actual lessons gave the teacher educators a direct experience that manifested itself in both the curriculum design and the teaching of methods classes.

Evaluation

Evaluation consisted of participant questionnaires, interviews by an external evaluator, and the project directors' observation of some of the teacher educators' redesigned methods classes. In a few cases, the directors were able to observe the peer teaching and practicum activities of the undergraduates trained in the new methods courses.

The observations led to the conclusion that teacher educators were indeed incorporating their new learnings in the preparation of FLES teachers, and that their students were carrying that learning into their pre-service practica. The external evaluator, based on her analysis of questionnaire responses and interviews, found that the project had quite strongly met the goals of improving the ability of teacher educators to train future FLES teachers, facilitating collaboration among teacher educators and practicing FLES teachers, and building a statewide capacity for professional development in teaching foreign language in the elementary schools.

This project established the value of having in-service teachers mentor teacher educators, a lesson that might be applied in a variety of situations where college faculty lack experience in specific aspects of the training they are expected to provide.

Project Impact

In addition to building the curricular and instructional support that would allow the state to meet its goals for incorporating foreign language instruction into the elementary school curriculum, this project created a new sense of partnership among university and elementary school faculty. The personal relationships that developed facilitated the placement of college students for practicum experience and expanded the role of university and college faculty in the schools. The elementary teachers' experience as mentors for college faculty gave them a new confidence and sense of equal partnership in the educational enterprise.

Lessons Learned

The project model did indeed work. Participant feedback and the project directors' monitoring led to recommendations for minor changes. The most valuable elements of the program were the concept of having FLES teachers mentor teacher educators and the equal partnership of the two groups in curriculum development.

Project Continuation and Recognition

The project was designed to end with the training of a cadre of teacher educators and the development of the new curriculum and its implementation. The ongoing effects lie in the network of relationships developed by the participants.

Budgetary problems delayed full implementation of the elementary school teaching mandate until 1995. Since all programs that prepare elementary teachers implemented the FLES curriculum, all new teachers were ready to offer foreign language instruction in grades K-6.

The model curriculum attained such wide currency that the sponsoring organizations had to employ an established agency to reproduce and distribute copies. Several state systems—notably Arizona's—where similar requirements for elementary foreign language instruction are being instituted have used the expertise developed in North Carolina extensively. Project staff have been invited speakers at national and international conferences.

Available Information

Copies of the model curriculum (cost: $8) are available through:

User Services
ERIC Clearinghouse on Languages and Linguistics
1118 22nd St., N.W.
Washington, DC 20037

Information about the project activities may be requested from:

Nancy Rhodes
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1118 22nd St., N.W.
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NEW YORK HALL OF SCIENCE
The Science Teacher Career Ladder

Purpose

New York Hall of Science (NYHOS) museum, in cooperation with Queens College of the City University of New York, recruits undergraduates to careers in science and science teaching by engaging them as "explainers" at the museum. At the time of its inception, this effort was unusual for such an institution, but had the potential for replication at any of the 200 science and technology centers in the nation, nearly all of which are located in close proximity to a university. The program especially aimed to provide access to science teaching for women and minorities.

The need for minority teachers in general, and minority science teachers in particular, remains critical. In New York City alone, over 3,000 teachers took early retirement in 1995, creating a critical shortage of math and science teachers. In 1970, teachers of color made up more than 9 percent of the national teaching force in all disciplines, but that percentage is dropping and may decline to 5 percent by 2000, when 33 percent of the school age population will be children of color.

The "explainers," mostly women and minorities, work with children and adults visiting the center, doing demonstrations and helping them with the hands-on exhibits. They currently include both science and non-science majors.

Innovative Features

Students attending Queens College or transferring from community colleges were attracted to the program by the opportunity for paid work and the waiver of tuition for science and education courses. The waiver was contingent on recipients teaching science in the schools for two years after graduation. The college provides a seminar to connect work at NYHOS with the students' courses, which helps to form a close-knit community among the students, a challenging task at large commuter institutions.

As they gain experience with the program, students move into increasingly complex roles as explainers, with concomitant increases in salary. They may use their work at the Hall of Science in partial fulfillment of student teaching and/or field requirements.

Through the informal instructional activities at the Hall of Science, program participants learn new ways to teach science and break loose from the rote learning strategies that many of them experienced in the public schools.

Evaluation

In 1991, an evaluation was conducted by an external group employed by NYHOS. The evaluators looked largely at participant responses to their experiences, using questionnaires and interviews. In particular, they explored four hypotheses:

> 1) that exposure to an informal science-rich environment would attract students to teaching careers;
>
> 2) that paid employment as a science interpreter in a multi-ethnic setting would attract minorities;
>
> 3) that adaptation of a pre-service program to student needs would keep undergraduates engaged; and
>
> 4) that the balance between formal and informal experiences would provide a solid foundation in both science content and hands-on methodologies.

A second evaluation conducted in 1994, using focus groups and surveys, examined the usefulness of the program for employment.

Project Impact

By the end of the funding period, 51 Queens College students had enrolled in the program. Seven other New York City colleges and universities, five public and two private, had joined the Science Teacher Career Ladder (STCL) program, contributing an additional 48 students for a total of 99. Each of the eight institutions appointed a liaison to the program, and these individuals meet as a committee with NYHOS staff to coordinate activities.

The program expanded rapidly to include high school students and non-science majors, and STCL became part of a larger Science Career Ladder which has to date over 400 students.

There is confirming evidence for each of the hypotheses listed above.

1) Follow-up of 99 students in 1994 after the project ended found 34 percent engaged in teaching at the elementary level, 9 percent working in museums, and 15 percent in science related careers. Of the alumni who are teaching, 21 percent are African American, compared with a national average of 5 percent African-American teachers; 14 percent are Asian, compared with a national average of 1 percent; and 13 percent are Hispanic, compared with a national average of 3 percent. On a scale of 1 to 5, where 5 is the most positive and 3 the neutral response, the group showed weak agreement with the statement that the program increased their commitment to teaching. That no doubt reflects the balance between those who opted for a teaching career and those who decided against it. The students felt that they had learned to work with different kinds of children (4.6), improved their ability to teach children (4.4) and grown in their ability to manage children (4.1).

2) Of the 99 participants, 82 were women and people of color.

3) Attitudes toward science were enhanced. On the five point scale, students felt that their general interest in science had increased (4.5), along with their comfort level (4.3) and breadth (4.4) and depth (4.3) of knowledge. Curiosity about how things work also increased (4.4) as did general love of learning (4.0).

4) Students agreed that their ability to do hands-on science teaching had improved (4.4). They felt that their confidence in teaching science as well as their general self-confidence had increased (3.9 and 4.0 respectively).

Lessons Learned

STCL demonstrates the opportunities for colleges, universities and community institutions with an educational mission to collaborate in the education of college students. The role of museums and science centers in teaching school children has long been recognized, but STCL is one of the few cases in which such an institution has exercised a formal role in postsecondary education, apart from serving as an internship site for individual students. The example is suggestive not only for the preparation of science teachers but for other combinations of institutions and fields of study; e.g., historical societies working with social studies teachers or libraries with literature majors.

Project Continuation and Recognition

This program has attracted a great deal of attention, and funds totaling nearly 4 million dollars from federal, state and city governments, foundations, corporations and private donors. This funding and the appeal of the design have led to full institutionalization of the program at NYHOS and at some of the other participating colleges and universities. While Queens College continues the program, the close relationship with NYHOS has somewhat weakened.

Funding was secured for formal dissemination, including a replication conference. Such dissemination has resulted in adaptations of the program at twelve science museums, and the purchase of replication materials and/or attendance at workshops by 53 science centers.

Available Information

In 1991, general assessment of the role of science-technology centers in teacher education was completed by Inverness Research Associates, the first evaluators for this project, and is available from them (P.O. Box 313, Inverness, CA 94937). In December 1994, a second comprehensive evaluation tracking STCL alumni was done by Illona Holland Associates.

Details about program operation and copies of the replication manual and videotape are available from:

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PACE UNIVERSITY
Case Studies for Teacher Trainers

Purpose

As new teachers move from their classroom study of educational principles and strategies to practica and first jobs, they must cross the gap between theory and practice. But the ambiguous circumstances in the classroom, where the majority of questions do not have a single right answer, differ markedly from the hypothetical and clear-cut situations they encountered in their texts.

By developing case studies modeled after those used in hundreds of business schools, Pace University instructors hoped to bring the practical problems of real school classrooms to education courses, thus providing a link between theory and practice. The cases, based on classroom problems faced by individual teachers, were chosen in order to lead students to apply the theories and principles they had learned to actual classroom situations, and to become reflective about their own teaching. The case studies encourage analysis and problem solving rather than identifying the "right" answers. They give students the opportunity to ask important questions, to consider various responses, to argue for or against different solutions, and to understand that successful teachers have to be able to think through situations and evaluate several possible solutions.

In higher education today, the definitions of "case" range from brief scenarios to lengthy histories of individual students. Furthermore, cases may be written as instances of exemplary practice, to highlight a specific theory or to elucidate pedagogical thinking. For the purposes of this project, however, a case was defined as the "the reporting of complex classroom events based on the experience of practicing teachers, and ending in a dilemma." Cases were intended to serve as cues for reflection and application of theory.

Innovative Features

At the time the project began, the kinds of cases and discussion techniques that have been so widely used in business education were rarely employed in teacher education. This project changed teacher education programs substantially by adapting case study pedagogy pioneered at the Harvard Business School, and introducing case analysis to better prepare students for their future experiences and first placements as teachers.

The work at Pace was a joint effort of members of the Business and Education faculties. Illustrative cases were gathered from teachers and written in the initial stages by the project directors, and later by graduate students in education. They were reviewed for accuracy by the teachers who had volunteered their classroom problems for such treatment.

The project directors classroom-tested the completed cases, revised them to provide greater detail, clarity and definition, and tested them again. Of the 40 cases thus developed, 28 were initially published for classroom use, along with an instructor's manual.

Evaluation/Impact

Much of the evaluation evidence comes from observations of students in the case classes. The faculty observed that students prepare actively for case classes, which results in their energetic and thoughtful engagement in discussion and problem solving. Formerly inert students get involved, and the discussion continues during class breaks and into the halls after class. A reporter who observed a case class described that involvement by saying, "When the...students read this account (the case), it took no prompting...for the class to jump into a lively discussion of the case....(S)tudents offered an array of advice and suggested ways of resolving specific aspects of the complex situation." (*Education Week*, March 28, 1990, p. 18)

The project directors have completed three formal research projects. The first, "Student Outcomes from Teaching with Cases," was presented at the AERA Annual Convention in 1991 and reported the results of a qualitative research study with students who had taken a case-based educational psychology course. The project directors used content analysis of student papers as the primary research technique and found that, over time, students became more analytical in their approach to problems, were more likely to evaluate a variety of solutions rather than being satisfied with one right answer, were more open to their fellow students' ideas, applied theory to support their ideas, and displayed more satisfaction with the quality and quantity of their learning in their case-based course. Further, over the long term, students who had been exposed to case method teaching reported that this training had made them better classroom observers, so that their field experiences made more sense.

The second paper, "Using Case Method to Link Theory and Practice in Two Educational Psychology Courses," was written with Judith Kaufman of Oklahoma State University. The research upon which the paper is based, gave students in two classes, one case-based, one lecture-based, the same case to analyze in writing at the beginning and the end of a course. Using content analysis, the authors looked for evidence of students' ability to link theory with practice. They found significant evidence that students in the case-based class could apply theory to teaching situations much more readily than their peers in a lecture-based educational psychology course. The case-trained students had a better understanding of the meaning and application of educational psychology theory at the end of their course. It is important to note that all students in the case-based class were able to use applicable theory, while only half of those in the lecture-based class were able to.

Finally, the project directors' paper, "Teaching Without a Net," in a book edited by Joel Colbert and Peter Desberg entitled *The Case for Education: Contemporary Approaches for Using Case Methodology* (Allyn & Bacon, in press), reports on observational research of students in case-based courses and how their training enabled them to internalize a problem-solving heuristic which they could apply to teaching situations whether presented in case form in college classes or in their own classrooms. They had learned how to analyze teaching situations by taking other perspectives, identifying a range of problems and offering and evaluating a variety of possible solutions. Furthermore, these students recognized that such an approach enabled their learning about teaching to continue outside of the teacher education classroom. They reported becoming reflective practitioners, thinking about teaching by considering their own teaching practice.

Project Continuation and Recognition

The project directors realized that the single most important factor holding back widespread use of case methodology was the inability or reluctance of a large majority of faculty to use the pedagogy effectively, since the use of cases calls for teaching behaviors quite different from the traditional method.

At the end of the FIPSE funding, the directors established the Center for Case Studies in Education to continue the case development work and to provide training for college faculty who wanted to learn to teach using cases. The Center is funded by income received from case book royalties and from workshops and conference fees.

By 1995, more than 60 cases had been developed and were available for course adoption through McGraw-Hill's custom publishing venture *Primis*. In addition, a workshop model was developed to help faculty understand the dynamics of case method pedagogy. An extended program was instituted at Pace to train the entire teacher education faculty in case method pedagogy, and by 1995, more than 60 percent of the teacher education classes were at least partly case-based. In addition, more sophisticated evaluation projects began to measure the impact of case method training upon teaching behaviors.

The project directors were funded again by FIPSE from 1991 to 1994 to develop a series of case studies to better prepare faculty for the realities of teaching in the diverse college classroom. Twenty faculty development case studies and teaching notes were completed and disseminated widely in workshops and seminars designed to encourage faculty to think more critically about effective teaching. Just as in the first project, these cases and workshops were greeted with great enthusiasm, but often the enthusiasm did not carry over into actual change in everyday teaching behaviors. It was clear that something more than a short workshop was needed to stimulate faculty to change long-practiced behaviors.

Combining this insight with the success of the original program which trained faculty in case pedagogy, the directors won a FIPSE dissemination grant in 1995 designed to adapt the Pace model for the training of case teachers at five other institutions throughout the United States. They will engage each campus in evaluation activities to determine the effectiveness of this approach. Each university is committed to further disseminating its own work to other schools in their geographical area.

The Center for Case Studies sponsors, in cooperation with the American Association for Higher Education (AAHE), a national conference each summer on using cases to promote reflective practice among higher education faculty. Regional workshops on the effective use of cases will be offered in five sites around the U.S. in the near future. In addition, the project directors continue to offer workshops on case teaching and case development at national conferences and for individual colleges and universities. Their work has been reported in The New York Times, The Chronicle of Higher Education, and Education Week.

The project directors have worked with national organizations and with individual schools to introduce case methods into schools of agriculture, forestry and natural resources, nursing, science, social work, veterinary medicine, engineering, pharmacy, and military science.

Available Information

Case Studies for Teacher Problem Solving and the accompanying instructor guide are published by McGraw-Hill, as well as the 60 teacher education cases referred to earlier. Information about the resources and activities of the Center for Case Studies in Education, a bibliography on case writing and teaching, and a catalog of case studies are available from the Center. Staff will annotate the catalog if instructors indicate particular areas of interest.

For more information contact:

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UNIVERSITY OF OREGON

Beyond Academics in the Preparation of Education Leaders

Purpose

Most university programs to prepare elementary and secondary school administrators are almost entirely classroom-based, include little instructional collaboration between university faculty and practicing administrators, and emphasize management over leadership. This project incorporated substantial field-based components, involved practicing school administrators as co-teachers with university faculty, and gave equal time to the instructional leadership and school management aspects of the principal's role. The two-year weekend and summer program served a cohort of 25 teacher-leaders preparing for a possible future in school administration.

Innovative Features

Project leaders recruited a group of 25 teachers, 24 of whom completed the program, to study as a cohort during two years. The program for the first year consisted of seven weekend seminars of 15 hours each, dealing with the skills of instructional leadership such as team building, teacher supervision, and creating a climate for change. During the first summer, participants completed four school management courses and a series of activities at the Assessment Center of the National Association of Secondary School Principals (NASSP).

The Assessment Center identified the skills on which each participant needed to work. These were perfected during a school-based internship in the following year under the tutelage of an experienced principal. Five 20-hour seminars for the participants and their mentors accompanied the internship. Students completed the program the second summer with two additional management courses, and were awarded a school administration certificate.

Major innovative features of this program, in addition to the cohort model, the faculty/school administrator co-teaching, and the equal emphasis on instructional leadership and school management included: 1) using the NASSP Assessment Centers as a diagnostic tool to help structure the internships; 2) requiring internships before awarding the certificate; and 3) maintaining the support network among members of the cohort during their first year of full-time administrative work.

Evaluation/Project Impact

The evaluation included five studies. The first explored the students' evaluation of the first-year seminars and examined the degree to which they used the leadership concepts and skills taught in the seminars during the internship year. Results showed that students made ample use of those concepts and skills, and could articulate the ways in which they used them.

The second study compared the program participants to a matched group of students completing the university's standard administrative training program, and showed that the experimental group understood their application of the skills and theories about instructional leadership far better than did the control group completing the conventional program. This result was particularly significant in that the two groups demonstrated virtually identical levels of understanding of these matters in response to the same set of questions asked before their programs began.

A third study showed that students in the experimental group were much more successful than the controls in securing administrative positions after they had completed their certificate programs. The fourth study, based on opinions of supervisors, peers and subordinates about the experimental group members' performance in their first year as administrators, showed an unusually high degree of success. The fifth study demonstrated that the positive effects of the experimental program were still being realized five years after its completion.

All but one of the 25 members of the program completed it, one individual dropping out for personal reasons. Of the 24, thirteen were appointed immediately to administrative positions, more than double the average rate of 25 percent for holders of new administrative certificates. One additional individual was unsuccessful in getting an administrative position the first year but did get one a year later, along with six other members of the group. Thus by the beginning of the second year after the end of the program, 20 of the 24 members of the cohort were in administrative positions, with the other four choosing not to pursue such jobs at that point in their careers. Five years later, 23 of the 25 were assistant principals or principals.

Lessons Learned

On the basis of the success of the participants in securing administrative positions and the enthusiastic endorsement by their colleagues, one can reasonably conclude that the emphasis on instructional leadership skills and the strong internship, which were the operationally significant elements of this project, are unusually effective strategies for preparing school administrators. While all of the innovative features listed above seem to have contributed to the success of the program, it may be the intentional and structured focus on the concepts and skills of leadership within a supportive cohort that produced such positive results.

Project Continuation

The success of the program led the University of Oregon education administration faculty to phase out the current classroom-based program in favor of a modified version of the program developed through this project. The University's College of Education is now committed to a weekend program with a strong internship as the only preparation curriculum it offers for school-based administrators. The department took this action on the basis of the follow-up studies of the experimental program graduates and the enthusiasm for it on the part of administrators around the state.

Available Information

Further information may be obtained from:

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POSTGRADUATE CURRICULUM AND INSTRUCTION

The two following projects reflect the current ferment in the training of high-level practitioners in many fields. They respond to perceptions that the content of the curriculum is not fully consistent with changes in practice. Thus the Georgetown Law Center experiments with a curriculum that, among other innovations, puts less emphasis on "black letter" law, and more on regulatory law and the social science theory that informs the practice of law. The California School of Professional Psychology, recognizing that their graduates' practices are increasingly multiracial, has thoroughly revised its curriculum to prepare students for that reality. Both projects illustrate the efforts by post-baccalaureate professional school faculty to look more carefully at the world in which their graduates will practice, and to come up with strategies more finely tuned to that world.

CALIFORNIA SCHOOL OF PROFESSIONAL PSYCHOLOGY AT ALAMEDA

Multicultural Education in Professional Psychology

Purpose

The faculty of the California School of Professional Psychology, Alameda campus (CSPP-A) were concerned that students in their graduate programs in clinical psychology did not have the training necessary to work with a culturally diverse population. This project sought to augment the content of required courses and introduce new requirements that would better prepare graduates to interact with ethnic minority clients.

Innovative Features

The eleven faculty teaching the "Introduction to Professional Issues" course required of first-year students began to change the curriculum by including a focus on the student's own ethnic identity as a major element of that course. Faculty responsible for the second year's "Seminar in Clinical and Ethical Issues" revised the course reader and developed clinical vignettes that would center class discussion on ethical and treatment issues that arise in working with minority group members.

Additional curricular offerings designed to address these needs included a required "Racism Awareness Workshop," a first semester experience in which students are asked to consider their own ethnic identities and race-based attitudes. For the second semester, CSPP added an "Intercultural Communications Laboratory," a term-long, team-taught course about the psychology of prejudice. The "Clinical Proficiency Progress Review," which students undergo in their third year, was augmented to include assessment of student sensitivity in working with an ethnically diverse clientele.

The new and revised offerings were based on a set of carefully stated clinical competencies for practitioners with a multi-racial clientele. These competencies are arranged in appropriate order over the entire course of the student's program.

The faculty training for the revised curriculum included presentations by a series of outside experts, discussions of clinical case studies that involve issues of ethnicity, and a conference of core faculty from each of CSPP's four campuses to share ideas about the new initiative. The campus library assembled a large collection of materials on the practice of psychology with diverse populations, based in good measure on topical bibliographies prepared by project staff. These materials were augmented by a number of relevant videotapes, including the expert presentations that were part of the faculty training activities.

In short, having determined to make certain that students preparing as clinicians would be able to deal sensitively and knowledgeably with a diverse clientele, CSPP made a systematic effort to introduce curriculum and instructional modifications great enough to make a difference.

Evaluation

Evaluation of both process and outcomes was conducted by an outside consultant. The process review consisted of interviews with key participants and examination of project documents. The central element of the outcomes review was a comparison of course descriptions and syllabi that predated the project with those that were being produced at the end of the project. The reviewer also examined the bibliographic materials and assessed the nature and extent of dissemination activities. A recent survey of students conducted by project staff also asked their opinions about the adequacy and effectiveness of the cultural diversity elements of the curriculum.

Project Impact

The comparison of course syllabi revealed major changes in content. By the end of the project, 81 percent of syllabi contained multicultural goals for the course, as opposed to only half in the pre-project period. Where earlier the goals had been stated very generally, goal statements in later syllabi are more specific and often stated operationally, e.g., "Conceptual models used in test development and normative test standardization will be examined for cultural bias." Reading lists contain a great deal more material on cultural diversity in clinical practice.

The project-end survey showed students about in the middle of a seven-point scale in their sense of the adequacy of attention to diversity issues. First-year students, who had benefitted more from the faculty's work on the project, were more satisfied than those in their third year. The "Intercultural Communications Laboratory" seemed to students the most effective effort. Experiences in the first year "Observation and Interviewing" and the second-year "Seminar in Clinical and Ethical Issues" were also highly regarded. In other words, students were well aware of the faculty's efforts to improve their ability to work with a multicultural clientele.

Lessons Learned

Project personnel were particularly conscious of the need to have faculty commit to the direction of change and to introduce program modifications with which they were comfortable. Thus the project was carried out using regular faculty channels and providing appropriate support.

The breadth of the definition of diversity to be employed produced the project's major controversy. Some faculty wanted to confine the definition to the legally established racial and ethnic minorities, and even here there was disagreement about emphasis. This group was concerned that to introduce issues of age, gender, sexual orientation, etc. would result in inadequate attention to any central matter. Others wanted to deal with the full range of individual differences. One compromise solution was the introduction of the rather narrowly focused "Racism Awareness" workshop and the more broadly inclusive "Intercultural Communication Laboratory."

Project Continuation

The curricular elements and instructional modifications, as well as the substantial additions to reading lists and library holdings, are now a permanent part of the School's program. The project appears to have made a quantum difference in level of programmatic attention to the issues on which it focused, and has been the subject of a number of conference presentations, regional and national as well as local.

Available Materials

Copies of bibliographies and course materials are available from:

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Alameda, CA 94501
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GEORGETOWN UNIVERSITY LAW CENTER
Reform of the First-Year Curriculum for United States Law Schools

Purpose

The first-year curriculum of United States law schools has remained essentially unchanged for a century. The focus is on common law topics—property, torts, and contracts—that are treated as sharply separated subjects and taught through a case method that emphasizes appellate decisions. The program characteristically lacks integration and attention to the pervasive role of legislation and regulation. It fails to give students a sense of the economic, social, political, and philosophical context of laws, and a sense of "the lawyering process," or what lawyers actually do.

Project faculty wrote a new first-year law curriculum which addresses the shortcomings of the traditional curriculum, and taught the eight newly devised courses to one section (approximately a fourth of the class) of entering students for each of two years.

Innovative Features

A radical restructuring of the traditional curriculum, the new first-year program allows for the introduction of historical, philosophical and social scientific considerations into the study of the law, while continuing to provide the essential basis of legal doctrine, procedure and argumentation that will enable students to succeed in upper level courses.

The new courses have such titles as "Bargain, Exchange and Liability," "Democracy and Coercion," "Legal Justice" and "Government Processes." Some courses draw the bulk of their illustrative material from a single aspect of the law, such as the "Government Processes" course, which focuses on workplace injuries.

A seminar that meets in small sections deals with largely jurisprudential topics that transcend the boundaries of other courses, and includes a critical evaluation of such contemporary movements as legal process theory and critical race theory. Even courses whose subject matter boundaries seem more traditional, such as offerings in legal process, legal writing and property, have a more historical and philosophical orientation than is customary.

Evaluation

The three following approaches were used to evaluate the original project:

1. **Student Response.** A wide variety of instruments measured student response, including computer-scored course and faculty evaluations and questions calling for discursive answers about expectations and actual experience. Students were surveyed at the time of graduation to learn about the effects of the program on their second and third years. A series of "town meetings" conducted during the first two years of the new curriculum gave students an opportunity to make suggestions for change.

2. **Faculty Reaction.** The Dean of the Law Center appointed an independent faculty committee to evaluate the experiment. Committee members attended classes and read syllabi and course material in order to prepare a report on each course and on the total effect of the program.

3. **Objective indicators.** The grades of students who completed the experimental first-year program were compared with those of other students in second-year courses to see if the differences in preparation resulted in higher or lower grades.

These same methods are being used to evaluate the project's continuation.

Project Impact

Students were generally pleased that they had enrolled in the experimental program, many finding it a better experience than what they believed the standard first-year curriculum to be. Negative responses resulted from such factors as lack of understanding of the nature of the new curriculum, the discovery by individual students that law was a poor career choice, and the inevitable problems that arise in the first offering of a new curriculum.

The performance in second-year courses of the first group of students to experience the experimental curriculum was generally the same as that of their classmates who had been in the regular program. No set of grades from an individual second-year course showed a marked difference in performance between the two groups.

The committee of faculty members established to follow and evaluate the program recommended its continuation for two more years for one of the four sections of first-year students. Since the project ended, three experimental courses have been taught by faculty who were not part of the original group, indicating a spreading of interest in the program among the Law Center faculty.

Lessons Learned

Instructors used the feedback from students and their performance in later courses to make a number of adjustments in the program. These changes dealt largely with clarifying goals for the students, avoiding redundancies, and including more instruction in traditional legal doctrine and standard modes of legal reasoning in one or two areas.

As project leaders learned, a program such as this one needs to take advantage of the particular strengths of individual instructors, even at the expense of adherence to a pre-existing plan. Faculty eventually realized that an experimental program is just that, and that mid-course corrections are therefore entirely appropriate.

Instructors attended each other's classes during the first-year of the new program, and met weekly throughout the first two years. This effort to coordinate instruction ran counter to the usual practice of teaching courses in isolation, and ultimately created a sense of common purpose that the faculty appreciated and that, when communicated to their students, became an important factor in the success of the project.

Project Continuation

At the end of the program's third year, the oversight committee decided that the experimental curriculum should continue to be offered to one section of the entering class for the projected five years. Thus, the project continues in much the same form as originally envisioned. Project leaders hope to involve new faculty into the program, thereby maintaining its vitality and increasing the numbers of those who have direct experience with it.

Available Information

Articles about the new curriculum have appeared in the University of Toledo Law Review and the American Bar Association Journal. A detailed description of the program and course syllabi are available from:

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